TRANSACTIONS
of the
American Philosophical Society
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VOLUME 80, Part 4

Berengario da Carpi On Fracture of the Skull or Cranium

translated by

L. R. Lind

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To my wife, Elena

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INTRODUCTION

I

Carpi is a small town in north central Italy, not far from Bologna on the road from Modena to Mantova. Here on market-days the farmers of the Romagna gather in the handsome piazza which faces the Castello dei Pio to greet each other and perhaps to shake hands loudly on a cattle deal. It was in 1870 that Don Paolo Guaitoli, a learned fellow-citizen of Berengario da Carpi, discovered by simply reading his last will and testament that his true name, hidden from everyone for centuries, was Jacopo Barigazzi, a fact later demonstrated from the Guaitoli archives by Professor Policarpo Guaitoli, Don Paolo's nephew. The notary who had drawn up the will had written his name thus: Iacopus filius quondam Magistri Faustini de Barigatiis (Jacopo, the late son of Master Faustino dei Barigazzi). The transition from Barigazzi to Berengario has not yet been convincingly explained, although Vittorio Putti thinks it is probably a dialectal corruption of the name Barigazzi.

It was, however, under the name of Berengario that he brought fame to himself and to his native town, of which he is today the most well known of all its citizens. Carpi also appears with his name in all his books and it seems that he thus preferred to identify himself with a place-name often used also by his great friend and patron, Alberto Pio, lord of Carpi, whose life has been written by Policarpo Guaitoli ("Vita di Alberto Pio," *Memorie storiche e documenti sulla città e sull' antico principato di Carpi*, Carpi, 1877). Berengario was born at Carpi, but the year of his birth is unknown. The single clue we have is the phrase *satis puer (De Fractura Calue*, etc., f. LVIII a, 1518; f. LXI a, 1535 edition) which he uses of his presence at the cure by Jacob Ebreo of Duke Ercole I of Ferrara, who was wounded at the battle of Molinella in 1467 when Berengario might have been at least seven years old or perhaps a little older, around ten, in which case he was born around 1457. He was one of five children born of Faustino and Orsolina (née Forghiera) Barigazzi.

His father Faustino, whom he seems to have often accompanied on his rounds, was a barber-surgeon of some renown who attended patients such as Bernardino da Vicenza, who was wounded by Bernardino Spaccini with a pruning-hook (both were soldiers of Marco Pio of Carpi: *De Fractura*, etc. f. XLIV b) and a certain Riccio, coachman of the house of Pio, whose skull was struck by a heavy nail (ibid., f. XXIV a). In his commentary on Mundinus (*Commentaria*, f. 225 a) he records the excision of the extruded matrix of a goldsmith's wife at Carpi by his father around 1490, when Berengario had already attained his doctorate in medicine.

Nothing is known of his early education beyond the important influence of his father and Berengario's own scanty reference to his boyhood schooling. His youth was spent at Carpi and he enjoyed to some extent the companionship of Alberto Pio, to whom he dedicated his brief account of anatomy, *Isagogae Breves* (see my translation: *Berengario da Carpi, A Short Introduction to Anatomy (Isagogae Breves),* University of Chicago Press, 1959; reprinted by The Kraus Reprint Co., New York, 1969). He says that he shared with Alberto the tutelage of Aldus Manutius (who arrived in Carpi around 1469) and with whom he participated in the dissection of a pig, perhaps in the Pio palace. Alberto was born in 1475 and was thus some years younger than Berengario. His uncle, with whom he later spent much time at the court of the Este family at Ferrara, was Pico della Mirandola, who died in 1494. Although both Haller and Putti are skeptical about the closeness of this relationship with Alberto as well as the effects of Manutius's instruction, especially upon Berengario's Latin style, there is nothing to indicate that Berengario was not writing from actual experience in the dedicatory letter prefixed to the *Isagogae Breves* (1522) even if this was set down many years after his youth in Carpi.

Berengario obtained his doctorate in medicine at Bologna on August 4, 1489. One of his sponsors and thus probably one of his teachers was Giovanni Garzoni; the certificate of approval for the degree is filed in the Archbishop's Archives at Bologna. Among his colleagues in the *Studio* of Bologna as he began to teach were several famous medical men: Gerolamo Manfredi, Leonello dei Vittori da Faenza, Alessandro Achillini, Giovanni Garzoni, and Gabriele Zerbi. Against the last he leveled bitter attacks while admiring Zerbi's undeniable medical prestige (see *Commentaria,* f. XVII b: Contra Zerbum, written when Zerbi had been dead for fifteen years). With Achillini Berengario had a professional acquaintance (ibid. f. 496 a), but he speaks rather spitefully of his *confusa anatomia,* i.e., Achillini's *Annotationes Anatomicae,* translated in my *Studies in Pre-Vesalian Anatomy: Biography, Translations, Documents* (Philadelphia, 1975) 23. Achillini died in 1512 and Berengario's *Commentaria* were published in 1521.

The conflict between the Pio cousins, Alberto and Giberto, which had been more or less settled in 1498 by the intervention of Ercole I, duke of Ferrara, under the authority of the Emperor Maximilian at Carpi, had placed Berengario, as the adherent of Alberto, in disfavor and he barely escaped both a fine and mutilation in a trial which took place on October 17, 1500. The years he spent at Bologna before and after he attained the doctorate are not well documented. In fact, much of the information about his life is to be found scattered throughout the personal case-histories, usually with dates and names, he gives in both the *Isagogae Breves* and the *De Fractura,* with occasional instances in the *Commentaria* as well. The almost incessant quarrels of the Pio cousins, Duke Ercole, and Lodovico il Moro, between Carpi, Ferrara, and other city-states in the latter years of the fifteenth century left Berengario finally unscathed as did the struggles between the Bentivoglio, Gonzaga, and Este families and the descent of Charles VIII of France into Italy in 1494. From the arrival of syphilis from the New World in these very years he was also to garner riches in its treatment with guaiac and mercury ointment; he edited Ulrich von Hutten's book on the disease in 1521.

Although foreigners (except for extremely few and highly recommended persons) were not allowed until the later years of the fifteenth century to teach in the *Studio* of Bologna, exceptions were increasingly frequent in the four faculties of law, philosophy, medicine, and humanities. Despite the opposition of the ruling Bentivoglio family at Bologna toward those sympathetic to Alberto Pio, Berengario was elected to the chair of surgery in 1502 and to that of medicine in 1505. A chair in anatomy *per se* was to be established only in 1570 and occupied by Giulio Cesare Aranzio. It was probably to his wide practical and clinical experience, his reputation for successful cures, his distinguished friends, and his skill at operating that Berengario owed this extraordinary appointment as a non-citizen of Bologna (see *Liber Partitorum*, May 5, 1503, for his annual stipend of 100 lire). By a brief from Pope Julius II dated December 4, 1506, Berengario was granted Bolognese citizenship, shortly after the Bentivoglio had fled from Bologna and the pope had triumphantly entered the city. The records of the university note the fact that he was a more popular teacher than his companion, Domenico della Lana (*Rotuli*, 1503- 1512: Ad lecturam chirurgie). In 1508 during an outbreak of plague Berengario was charged by the city government with combatting its ravages as chief health officer, a post he held until 1512.

During the reign of Pope Julius II (1503-1513), Berengario spent some time at Rome. It was to Julius that he dedicated his largest and most important work, the *Commentary on Mundinus* (1521). Documents of 1511-1512 in the Archivio di Stato of Bologna give the details of outrageous attacks committed by Berengario on the persons and property of Giovanni Battista de Forzani and Natale da Brindisi, the first a physician and the second a papal stipendiary. From both disgraceful acts of aggression Berengario emerged unpunished.

In 1514 he published his first book, an edition of Mundinus, *Anatomia*, of which only four copies are extant, perhaps showing how popular it must have been among readers. According to its preface he was already at work on the huge *Commentaria*. His contribution to the text of Mundinus, exclusive of his commentary, is negligible, but the publication represented a reaction against the Galenic and Arabic tradition which was beginning to characterize the study of anatomy in the early sixteenth century. The next years were Berengario's most fruitful in terms of publication and he grew rich from his fees as well as from his books.

His wealth was carefully invested in at least nine pieces of property in Bologna from 1515 onward. He also collected objects of art. These included a headless marble statue of a Roman emperor in armor of the first century A. D. which had once adorned the forum of Bologna, now displayed in the Museo Civico, and a painting of St. John in the desert by Rafael, now in the Royal Gallery (see Vasari, *Lives of the Painters*, Rome: 1759, 2: 124-125). He carried away from Rome together with their drawings some silver vases which were made by Benvenuto Cellini, who mentions Berengario's avarice and high fees in the treatment of syphilis by fumigation at Rome. The vases brought Cellini a great deal of admiration and he was paid well by Berengario, who as he says "was very learned and could speak admirably on the subject of medicine" (*The Life of Benvenuto Cellini*, Everyman's Ed., New York: E.P. Dutton, 1907, 51-52).

In 1517 Berengario was called to Ancona, where Lorenzo dei Medici had been wounded, resulting in an occipital fracture and consequent shock trauma, on March 28. His treatment is described in *De Fractura*, f. 25 b. Lorenzo's skull is now in the family chapel in San Lorenzo, Florence. Vittorio Putti supplies a photograph and describes both the skull and the operation performed on it in great detail (*Berengario da Carpi: Saggio biografico e bibliografico seguito della traduzione del "De Fractura Calvae sive Cranei," Bologna, 1937). The event represented a significant advance in Berengario's professional experience, recorded in the De Fractura*, which was inspired by the occurrence and written in little more than two months after his return to Bologna. He dedicated the work, appropriately enough, to his patient, Lorenzo, to whom Machiavelli had also dedicated *The Prince* in 1513.

In 1520, following the pattern of his violent disposition, Berengario became involved in a shabby affair at law with a certain Zambelli Petenghi, whose house he had deliberately invaded with the intention of wresting it from its owner. Protected as usual by prominent friends, Berengario escaped in this incident as well as the presumable consequences of his greed and violence by a technicality of legal procedure. As Putti writes: "Avarice and cupidity arouse in the spirit of this great man stronger passions than glory or virtue" (*Berengario*, p. 55).

In 1521 he had published both the *Commentaria* and had procured the publication of Hutten's work on cures for syphilis. In 1522 he published both an edition of Galen's *De Crisibus* (Vol. IX, C. G. Kühn) and the *Isagogae Breves*. The latter holds by a rough analogy the same position in reference to the *Commentaria* as Vesalius's *Epitome* does to his *Fabrica*, that is, as a brief introduction to a much larger book. Berengario advises those who are not satisfied with the quite compact information he gives his readers in the *Isagogae* to have recourse to the *Commentaria*, into which he had poured the abundance of his knowledge and experience. Apart from the book by Hutten and the editions of Mundinus and of Galen, Berengario's original contributions were published within a four-year period, 1518-1522, as he reached and passed his sixtieth year.

In the early years of Pope Clement VII's reign Berengario visited Rome a second time and stayed for about five months in 1525-1526, as shown by the documents (*Punctationes*) which record the absences of Bolognese professors from their teaching duties. Just as Pope Leo X had called him to Florence to attend Alessandro Soderini, a relative of the pontiff, so Clement VII had sent for Berengario to help cure the Cardinal Pompeo Colonna, suffering from a carcinoma, who eventually died in 1532. It was during this visit that Berengario met Benvenuto Cellini. His cure of the cardinal was so successful that he left Rome for Bologna enriched by a large fee and the gifts of art objects mentioned earlier.

The last year of Berengario's teaching career extends from the spring of 1526 to January 24, 1527. According to Falloppio, *De Morbo Gallico* (Padua, 1563), Berengario was accused of practicing vivisection on two Spaniards. Such a charge was in earlier years leveled against other medical men, Herophilus, Erasistratus, Celsus, the physicians of the king of France, and Vesalius in their day, with as little basis in truth. This cannot be the reason Berengario left Bologna and his teaching post because there is nothing of any consequence to support it. The misinterpretation of a passage in the *Commentaria* (f. 336v) concerning the water which issued from the side of Jesus as he hung upon the cross as a miracle and not as a physical reaction may have had something to do with this turn of events in Berengario's life, but a close inspection of the Latin text shows that he regarded the water as miraculous and that he intended no blasphemy.

In 1512 Achillini had also fled from Bologna at the approach of papal troops, as had Pomponazzi from Ferrara in 1510. They too were adherents of the Bentivoglio, who opposed the invasion without success. Gabriele Falloppio, *De Tumoribus*, chap. xi, writes that Berengario wandered about some unmentioned city offering his medicaments to victims of the pestilence in 1527. Beyond this vague report from a hostile witness we have no knowledge of his whereabouts during a plague which swept over all Italy. On March 24, 1528, he recorded his last will and testament, dated at Carpi. We have documentary proof that he was still practicing medicine, this time at Modena, a few miles away, on July 27, 1528. In 1529 he entered the service of the Duke of Ferrara, one more instance of his ability to seize every opportunity to better his fortunes with popes and potentates by ingratiating himself with them. In the same year he published his last book, a revision of several works of Galen in Latin translations by other men, and dedicated it to Cardinal Ercole Gonzaga. Since the book appeared at Bologna, it seems that he had not broken all ties with that city and no doubt traveled thither from time to time during its publication. The publisher Gerolamo Benedetti had printed his three most important books, the *De Fractura*, the *Commentaria*, and the *Isagogae Breves*, but Giovanni Battista Faelli published the collection of Galen's works.

The occasion for the preparation of this book was a banquet in 1529 arranged by the cardinal in the Orti della Viola at which not only Berengario but Pietro Pomponazzi, Lazzaro Bonamici (his former teachers), and Giovanni Francesco Forni, a disciple of Pomponazzi, and all three professors in Bologna were guests. The conversation turned toward anatomy. Berengario praised Galen and the young Gonzaga begged him to give more details on the structure and the viscera of the human body and to show him the books of Galen which Berengario especially prized. Hence arose the collection, and in an atmosphere of genial conviviality the greatest anatomist in Europe between the time of Mundinus and that of Vesalius (thirteenth/fourteenth century-sixteenth century,) disappears from the scene of his triumphs.

The Latin text of his last will and testament has been published twice, by Guaitoli in 1880 and by Martinotti in 1923. It was also published by Putti in a literal Italian translation in 1937. According to Guaitoli, Berengario died in Ferrara on November 24, 1530, and was buried in the church of San Francesco. Putti, however, has found no record of his burial there, although his will specifies that he should be buried in that place. The document lists his books, a quite respectable library, as well as his other possessions. His chief heir was Damiano, the son of Berengario's brother Giovanni Andrea. He seems to have had only one child, a daughter named Faustina, who is mentioned in the will but who was dead before its date. He had been married to a Bolognese woman by 1506, the date of his entry into Bolognese citizenship, but had no children by her at that time.

II

As its colophon declares, the *De Fractura Caluae* was published by Hieronymus de Benedictis (Girolamo dei Benedetti) at Bologna in December, 1518, in a quarto volume of 105 folios, of which eight copies at least are extant. The History and Special Collections Division of the Biomedical Library at the University of California, Los Angeles, has recently acquired another copy. Somewhere between 1518 and 1535 another edition appeared of which one copy exists in Bologna. Other editions followed: Venice, 1535; Leiden, 1629, 1651, 1715, 1728. The last three are reprints of the 1629 edition. Such popularity extending through at least two centuries indicates the value which later generations placed upon the book.

It is certainly the most important work on cranio-cerebral surgery of the early sixteenth century. Malgaigne (Putti, 243) also regarded it as the most important of all Berengario's writings. These statements become more convincing when *De Fractura* is set in perspective in the history of head surgery from Hippocrates to its day.

When we deal with science before the sixteenth century in Europe it is necessary to consider its nature in contrast with later and with modern science. Ancient, medieval, and early Renaissance anatomy constitutes a rather slow progress from authority to authority rather than from discovery to discovery. The advances made through actual additions to knowledge during that long period are few indeed and marked by a tedious and sterile series of quarrels over the meanings of words and the interpretations of would-be philologists, not over the accurate or inaccurate observations of true scientists seeking the truth more than victory in debate. This is the reason why it is dangerous to attribute to anatomists any particular innovation or important finding about the fabric of the human body. To them the geography of the human form was less a matter of genuine observation than an opportunity to match and heap up authorities.

Berengario is not free from this mind-set and reverence toward authority, although he occasionally asserts his independence of view and urges his readers and students to follow him in what may be called an elementary form of research. The method of modern science in gathering data based upon observed facts, weighing and measuring them in the laboratory, and subjecting the conclusions drawn from them to rigorous experiment was far beyond him in 1518 when he was planning and writing his book on skull fracture.

He quotes, often *in extenso,* or refers to (sometimes at second hand) Hippocrates, Plato, Aristotle, Diodorus Siculus (once on the Chaldaeans), Galen, Paul of Aegina, and Oribasius among the Greeks, with a glance at Dioscorides as herbalist; Cicero, Vergil, and the two Senecas, Celsus very often among the Latins; Haly Abbas, Avicenna, Rhazes, Avenzoar, Abulcasis, Mesue junior and senior, Rabbi Moyses, Serapio, Haly Rodoan among the Arabs; Johannes Alexandrinus on Galen's *De Sectis,* Roland of Parma, Theodoric of Bologna, Jacques Despars, Joannitius, Pietro D'-Abano (*Conciliator*), Lanfranc, Dino Del Garbo, Gentile da Foligno, Niccolò da Firenze (Falcucci or Falcuzzi), Jacopo da Forlì, Ugo Benzi da Siena, Pietro Torrigiano de'Torrigiani, Pietro D'Argelata, Albertus Magnus, Leonardo Bertapaglia, Guy de Chauliac (whom he calls Guido), among the later medieval writers. He twice mentions Maffeo De Laude, whose work I have supposed to be a *Quaestio de Fractura Cranei,* but about whom I can find no information. The Alexander (or Alessandro) da Ripa (or Riva) he mentions twice (once as his colleague with Tansura at an operation) is probably the man who received his doctorate in medicine at Bologna in 1509 (see my *Studies in Pre-Vesalian Anatomy,* 30).

The conflict between authority and progress in scientific thought was not settled in the last years of the fifteenth and the early years of the sixteenth century. As A. R. Hall says in *The Scientific Revolution* (Boston, 1956): "Thus the boundary between scholarship and archaism was indefinite, and too easily traversed ... such rigid adherence to the fruits of humanistic scholarship did not yield the renaissance of scientific activity beginning in the late fifteenth century" (p. 9). The early Renaissance still clung to the scholastic habits of the Middle Ages despite its much greater access to the ancient Greek and Latin texts, some of them by way of the Arabs and the great translators such as Gerard of Cremona. What Galen and Avicenna said about the human body still represented the high water mark of anatomical knowledge, while Mundinus remained only a skillful abbreviator of early works.

Thorndike, who examined closely only Berengario's *Commentaria* on Mundinus, declared: "Despite his interest on the one hand in humanistic textual criticism and on the other in the citation of scholastic authorities and the prolongation of late Medieval debates, Carpi was primarily an anatomist who relied first and foremost upon his own observation and experience." (*A History of Magic and Experimental Science* (New York, 1941), 5:50). Carpi disagrees with earlier writers such as Zerbi and states that he had dissected more than a hundred human heads solely in order to observe the *rete mirabile,* which he finally rejected as nonexistent. Although he did not believe that approaches such as astrology, physiognomy, and chiromancy influenced human anatomy, he nevertheless accepted without question a number of superstitions and ridiculous beliefs which Thorndike lists carefully.

As did all the anatomists of his time, Berengario was forced to work with the medieval system of physiology which included the members of the body, the qualities (hot and moist, moist and cold, cold and dry, dry and hot), elements (air, earth, fire, water), humors (blood, phlegm, black bile, yellow bile), temperaments (sanguine, phlegmatic, melancholic, choleric), causes (the Aristotelean four: material, efficient, formal, and final), the faculties or spirits (vital, natural, animal), the six non-naturals ("air, meat and drink, sleep and watching or walking, motion and rest, the retentions and excretions, and the affections of the mind, so called because they affect man without entering into his composition or constituting his *nature,* but yet are so necessary that he cannot live without them": Dunglison, *A Dictionary of Medical Science* Philadelphia, 1860), the complexions ("... the particular manner in which the four elements or four humors are mingled together..." C. Singer, in his translation of Mundinus, *The "Fasciculo di Medicina"* (Milan, 1924) 101-102; "...the quality which from the interaction and interpassion of contrary qualities found in the elements...with their opposing powers [that is, hot, cold, dry, wet]...there results a state of equilibrium (*summa qualitas*) similar to them as a whole, which is complexion": Avicenna, *Canon* I, fen 1, doctrina 3, chap. 1, p. 2); "accidents," chymes, and others. This strange amalgam formed the basis for a great deal of medical diagnosis and explanation of illnesses as well as a source of prophecy for an individual's future.

In spite of this *a priori* system of medical principles there is much personal observation in his book, and in this respect Berengario is superior to his pre-Vesalian contemporaries. No other man among them set down in his published works so much evidence of close scrutiny in clinical practice, apart from the general public dissections in which as all the others he engaged from time to time. The character of the *De Fractura Caluae* as a specialized treatise, a rare species among the pre-Vesalians, helps to account for this attention to individual cases, sometimes accompanied by the statement that Berengario had seen them handled or had been the chief physician in attendance. The book was inspired, in fact, by an important medical case, the head injury sustained by Lorenzo dei Medici, duke of Urbino, to whom it is dedicated, in 1518. Trepanation in which bone was removed without adequate instruments characterized the incident. Berengario witnessed in the same year the failure of every effort to save Ercole dei Marescotti from death by cranial contusions without fracture. Berengario conjectured that a small vein in his brain had burst and probably some nerve was damaged. At Bologna Piramo dei Pepoli (one of a famous family which held power in Bologna before the Bentivoglio family took it over) suffered a capillary (hair-line) fracture; Berengario was again a witness. During his practice in Florence a boy of twelve, the son of a dyer, was kicked by a mule resulting in the depression of large amount of cranial bone. In company with Alessandro da Riva and a surgeon named Tansura, Berengario lifted the bone only to find that a large vein had ruptured. The bone was released to hold back the flow of blood without ill effects. Such cases among children injured by falls were common in his experience. He cured them with his wax unguent (human flesh, called *mumia*). Filippo Donella, of Carpi, remained a year with a large piece of bone depressed under his cranium. From it blood flowed for six months. The man's brother and Berengario's father attended him; Berengario came on to the case later and extracted the bone, healing the patient thoroughly. Berengario treated with varying results, including apoplexy and paralysis, six men who had lost brain marrow because of fractures. Three of them he cured in this phase of his early youth in company with a good consultant. One patient he saw at Pistoia who was cared for by a Jew named Angelo also had lost brain marrow. At Bologna Vincenzo Ragaccia and Paolo, the nephew of Cardinal Tamás Bakócz, primate of Hungary, also required the extraction of bone from the head. The last case is one of his most famous and is described in much detail, including the dissolute behavior of the patient who drank and ate as he pleased and copulated with the house maid every other night during his convalescence. A farm overseer named Rumfa at Carpi also had suffered brain injury but insisted upon eating a large quantity of salted meat with bread and honey at night. Berengario demonstrated his skill at prognostication in the case of the son of Jacopo Maria de' Lino at Bologna by taking his pulse hourly and predicting the exact time of the patient's death. When he was a young man at Carpi, Berengario and his father attended a soldier of the lord Marco Pio who was wounded with a pruning hook which had split his frontal bone from top to bottom at the eyebrows. Berengario's father removed the damaged bone, sutured the skin, and applied his human wax. In other places Berengario had seen Germans fill the head-wound with salt alone to effect a cure.

Berengario's acquaintance with Jewish physicians seems to have been extensive. Around 1467 when just a boy he saw Jacopo the Jew, a close friend of Berengario's father, cure duke Ercole of Ferrara of a firelock shot in the foot. This man also cured lord Marco Pio of a fistula in the back and Antonello the Neapolitan, a cavalry commander, of a musket ball wound, also in the back, with medicine alone. The Jew took Berengario into the fields and meadows and showed him how to make a medicine from the herbs which they picked there. Another Jew, not named but also a good friend and an empiric, gave Berengario another potion, whose recipe

Berengario gives.

The *De Fractura Caluae* is a specialized treatise like Canano's booklet on the muscles or Dryander's anatomy of the human head, or Zerbi's anatomy of the pregnant uterus. It is also a school text which had been sought by Berengario's student at the *Studio* of Bologna. Its organization while at times a bit loose and repetitive is sound enough. The two very unequal parts into which it is divided concern (1) the extrinsic and intrinsic causes and types of skull fracture and (2) their symptoms and prognostications. The three types of fracture are by incision, contusion, and perforation, following Celsus's excellent survey of the entire subject of skull fracture and its treatment. Defining fracture as a broken continuity of the skull, Berengario goes on to give other names from various sources for it. Small philological and textual discussions crop up, as in the problem posed by Haly's *Practica* and *Pantegni* and its translation by Constantine the African. Here he quotes the opinion of Symphorien Champier in order to refute it, saying "It would be foolish to believe one man, Champier, against so many and such great men." Champier (1470s-1540 A.D.: Copenhaver; 1472-1538 or 1593: Sarton), a prolific scholar, probably made this judgment in his *Speculum Galeni ...*, of 1517 (see B. Copenhaver, *Symphorien Champier and the Reception of the Occultist Tradition in Renaissance France*, The Hague-Paris-New York, 1978, p. 20).

Berengario mentions three cases of lesion in which the point of contact as shown by a swelling and pus was ruptured. This phenomenon is exhaustively discussed in Part II, Chapter II. He goes on to symptoms and signs of cranial lesion in the second part of his book. These are few but important and necessary to identify. The means by which fractures can be ascertained include the use of a vibrating thread, the breaking of nuts by the patient's teeth, striking the head with a light stick, the use of black ink to discover a hair-line fracture, by touch, etc. To his credit Berengario considers most of these methods useless.

He weighs the authority of Celsus as second only to that of Hippocrates and stops to give a brief history of surgery in the day of the great Roman writer on medicine with liberal quotation from *De Medicina* and during the time of the great Arabs, Avicenna, Rhazes, Abulcasis, and others. He also mentions the works of more recent medical men, among whom Niccolò da Firenze has a large place. Signs of broken membranes are next discussed. At one point he mentions the *rete mirabile* which he had rejected in the *Isagogae Breves* of 1523 and with many reasons earlier in the *Commentaria* of 1521. In a passage in the *Isagogae Breves* he had reluctantly accepted the *rete* (if it did exist) as above the *dura mater* immediately below the *medulla* of the brain, but in the 1535 edition he totally rejected its existence.

Signs of brain lesion, concussion, vascular lesion, and bad complexion follow. It is hard to explain the last term, but a bad complexion seems to lead to an abscess. The humors (hot or cold) are the source of both bad complexion and abscesses accompanied by pus, with a glance at that strange phenomenon, laudable pus. The effects of heat and cold on head injuries are also discussed.

Abscesses form a large part of the succeeding series of analyses. The effects of pus also receive a great deal of attention. Chapter IX discusses the symptoms which arise from abscesses, fractures, or pus, and X takes up the pressure or puncture of a bone upon the membranes. Here occurs the term the "cheese grater" to describe the small roughnesses which appear on the membrane from the puncturing and broken bone. The results of such pressure on the membrane are often apoplexy due to chill as well. Discussion of opinions concerning the adherence of the dura mater to the cranium is taken up in detail, including its adherence at the sutures. Here Berengario brings in his experience with the cadavers of foetuses of four or five months of age, a time the *dura mater* is strongly joined to the pericranium, with a reference to the more detailed account of the subject to come in his *Commentaria*, published three years later. The signs of separation of the *dura mater* are then analyzed. Chapter XIII involves prognostic signs in head lesions with heavy use of both Hippocrates and Galen, who commented on the former's work on the subject. An eloquent passage here decries the rhetoric of those who dispute points of Hippocratic doctrine with empty words without knowledge, with a glance at the physicians who disdain to be called surgeons (Greek *cheirourgoi*, hand-workers, craftsmen) and at the loss of unity in the art of medicine which such an attitude implies in surgery particularly.

Rigors, chill, and headache receive much attention. External lesions of the head come next and their treatment with various applications of egg yolk, chicken fat, and rose oil, the last a sovereign remedy much emphasized throughout the book. Other unguents are described. Cure with a diet opens the discussion of the six non-naturals and their relation to a cure of fractures. Gabriele Zerbi in his unpublished treatise *Libellus de Preseruatione Corporum a Passione Calculosa* on kidney stone, of which I have prepared an unpublished edition of the Latin text with notes and introduction, also makes these non-naturals a central feature of his work.

Air as the first non-natural is thoroughly discussed, with particular reference to Aristotle. Food and drink are very important as are sleep and waking. Eliminations of various kinds are described and coitus sternly rejected except in certain cases vouched for by the Conciliator (Pietro D'Abano). A special form of elimination concerns the extraction of woman's milk while she suffers from head lesion. The mammillary veins should not be emptied at this time until the abscess has formed.

The final non-natural discussed is the emotions, which are very important for the patient's peace of mind. He should be kept happy in every way without setting his humors in motion. Adverse emotions such as anger, hate, fear, and sadness are to be avoided. Noise, bright lights, harsh sounds, talking about the patient's condition by those around him are also forbidden. Finally, the patient should have confidence in his physician, which is dependent upon a strong imagination. As the apostle says: "Thy faith hath made thee whole" (Matthew 9:22). The basic doctrine of the interaction of body and soul used here is drawn from Aristotle and Galen.

The cure of skull fractures through medicines alone forms a large part of the book and involves the arguments of the empirical sect to which many prominent physicians belonged. Eleven of their arguments in favor of medicine alone are presented, together with Galen's remarks in their favor although in general he despised the sect. Berengario finally settles for a removal of the bone or a moving aside of the bone together with the use of medicines as the most practical way of treatment.

In the course of the discussion of medicines the use of phlebotomy and clysters or enemas before the formation of an abscess is also analyzed. The reason why Avicenna did not use doses of local medicine in many places is argued, with the sensible conclusion that physicians cannot choose exactly the right medicament for all ages or complexions since dosage varies according to many factors. This reason is given in Galen's chapter on headache in *De Compositione Medicamentorum*. Proper dosage requires much experience. The exact kind and amount of medicine are still a medical problem but for other reasons than those given by Berengario. He emphasizes the difficulty of writing down what is largely a matter of practice and trial and error. He then gives a long list of recipes for unguents, plasters, and other external applications, most of them made with herbs. The last of these recipes advises the physician to place a leaf of red cabbage on the wound. Berengario's favorites included his human head wax (*mumia*) used by his father and handed down as a family heirloom but released for public use by Berengario, and his betonica and honeysuckle unguents. Later the question posed by the interpretation of Galen's remarks in his *Methodus Medendi* IV, 7, is taken up: are stronger medicines required for internal wounds and abscesses of the head than for external wounds?

At last Chapter XVI takes up the cure of cranial fractures by the use of instruments; it occupies the rest of the text, including post-operative care.

Berengario divides his instruments into: (1) trepanning devices or perforating tools which include raspatories, scalpels, forceps, small saws, and the lenticular of Galen; (2) elevators; (3) extractors, such as the serpentina. The trepan or trephine with a crown received a metal ring in Galen's day at least to prevent it from damaging the membrane. Galen, *Methodus Medendi* X, K. 447, named it *abaptiston*, the unbaptized, known to Berengario as *terebrum non profundans*. Berengario recognized that some instruments had to be invented for special purposes by the physician and had himself invented some which he used only once.

Giovanni da Vigo, from Rapallo (1460-1525), is a contemporary of Berengario whose *Practica copiosa in arte chirurgica* (Rome, 1514; abridged edition, 1517) must have been known to Berengario. Da Vigo describes a trephine which he had invented, so Berengario was not therefore in any sense a pioneer or an innovator in the area of surgical instruments. It is interesting to note that Berengario does not mention Da Vigo or any other close contemporary unless his reference to them in Chapter XVI as "the Genoese" is in contempt. According to Malgaigne, Berengario (see Ambroise Paré, *Oeuvres*, Paris, 1575, 2:58) was the first to present a figure of the brace to which was attached the drill or drills (he shows eight) for trepanning. It is the ancestor of the modern instrument.

The time when the bone must be moved aside or extracted entirely receives much attention. It is in this section that Berengario determines the fact that we do not possess Chapter 7 of Galen's *Methodus Medendi*, Book VI. The place from which the bone must be removed is also important, as is its quantity. Then the medicines to be applied are discussed. The use of rose oil is dwelt upon at much length. The use of his father's mumia is described. He is quick to assert that it is helpful chiefly in a case which is not desperate or impossible. The book continues with a description of the instruments (see above) and a discussion of whether one must begin the operation with a broad or a narrow instrument. The next item is a convenient summary of all the steps necessary in the process of cranial surgery. The last item is Berengario's operating manual, probably laid open at these pages on the tables of many students and successive readers in all of Europe down into the eighteenth century. His closing statement, Lectori Salutem, is one which Putti forebore to translate because he felt no translation could render the vivacity, the bitter and petulant arrogance, of the Latin prose. He closes with an index of the contents, another useful feature in what was intended as a school book.

The great authority on the life and work of Berengario da Carpi is Vittorio Putti. In his book *Berengario da Carpi ...*, he provides not only ample materials for a biography drawn from documents preserved in the Guaitoli archives at Carpi and those in Bologna, but also photographs of great interest dealing with the anatomist and his books. Twenty-two plates display various people and objects such as surgical instruments and the title-page of the first editions of Berengario's works. I have drawn heavily upon this book in writing the introduction to my translation as well as the more extended one published in my translation of the *Isagogae Breves*. I have there added a detailed bibliography of Berengario's writings as well as modern books and articles concerning his life and work down to 1959. There is a brief bibliography here as well.

Unfortunately, Putti's Italian translation (the first into any language) is heavily abridged. He has omitted whole sections, folio after folio of the 1535 edition he used, of material in which he had no interest and thus assumed that readers would have none. This includes the marshalling of authorities, the discussion of textual problems, and especially the frequent lists of medical recipes. Occasionally he has summarized long stretches of text. I cannot agree with his harsh criticism of Berengario's Latin style. He calls it rough and corrupt, obscure in thought, capricious in punctuation, careless with grammar such as agreement of verb and subject; for him Berengario is a Latinist of the third order who rises to eloquent heights only in his preface (a truly remarkable essay in its imagination and rhetorical skill) and in his farewell to the reader, which "show a certain style." The roughness of style is certainly not what one would find in Cicero, but it is a serviceable prose which is not hard to understand and adapted to his purposes. Although the punctuation is not always accurate or even present, it is never impossible to distinguish sentence from sentence and clause from clause. Berengario does not plagiarize the classics, as Putti accuses; he quotes them and acknowledges his sources faithfully. All in all, it is a workaday Latin not unremarkable among the Latin styles of the pre-Vesalian anatomists.

III

The *De Fractura Caluae* does not, of course, contribute much to our knowledge of the brain. Berengario, however, "published the first perceptual representation of the lateral ventricles," according to Clarke and O'Malley, *The Human Brain and Spinal Cord* (Berkeley, 1968), 721 (fig. 154 from the *Isagogae Breves*, ed. of 1523, p. 56: this is the first good picture of the embotum and the lateral ventricles seen from above). In his *Commentaria* (f. 438v) he "discussed the spirituous and fluid superfluities of the ventricles" and made an analogy between the ventricular fluid and that in the pericardial sac (f. 439r: Clarke and O'Malley, ibid.). The cerebrospinal fluid was "frequently observed but only in the ventricles of the brain until 1764." Berengario was "the first person to deny the presence of the *rete mirabile* in the human cranial cavity" (ibid., 764-766, with translated excerpts from the *Commentaria* and *Isagogae Breves*) and he explained "the apparent error by suggesting a defect of observation." Vesalius disposed of the *rete* by realizing that Galen, whom both Mondino and Berengario had followed, was describing the brain of the ox and not that of man. The *rete mirabile* occurs in ungulates but not in man (ibid., 758).

Berengario mentioned the cerebellum in his *Commentaria*, although Vesalius gave the first detailed account of it (ibid., 632). Johann Jakob Wepfer (1620-1695) was the first to present a detailed account of the carotid syphon and finally to disprove the presence of the *rete mirabile* in man. He happened accidentally upon the internal carotid artery as it passes through the carotid canal in the base of the skull "before I had read anything of these matters in Carpi" (ibid., 770). In my translation of the *Isagogae Breves* 17-19 I have assembled some opinions by prominent authorities as to Berengario's actual or supposed contributions to anatomical knowledge but these include chiefly parts of the body other than the head. Singer believed the earliest improvement on the medieval account of the brain, nevertheless, is to be found in the *Isagogae Breves* of 1522 (*The "Fasciculo di Medicina"*).

Berengario's primary interest in the *De Fractura* was naturally the exterior of the skull and in the post-operative care of the patient, to which he devotes a large part of his book. He followed Hippocrates, Galen, and Avicenna, with much reference also to Celsus among the ancients. He used Hippocrates, however, very slightly. The *Aphorisms* and *Prognostics* are referred to in Galen's commentaries on them, not in the original Greek. Hippocrates' work *On Injuries of the Head,* which is much more detailed and exclusively devoted to skull fractures, is not used directly except in Galen's references to it. This leaves us with Galen and to a lesser degree Avicenna as his chief sources, apart from his liberal use of Celsus in the first half of the *De Fractura.* But of Galen's works Berengario uses chiefly the *Methodus Medendi* (Vol. X K. under its old title, *De Ingenio Sanitatis*) rather than Galen's commentaries on Hippocrates' *Prognostics* (Vol. XVIII B. K.) which includes Galen's comments on Hippocrates' *On Injuries of the Head.* At Vol. X K. 444 Galen states that Hippocrates wrote an entire book on skull fractures and then proceeds to deal briefly with the subject, extending to the end of Book VI, 455, the book which so exercised the philological acumen of Berengario. He does not seem to have consulted the Greek text of Hippocrates in any of the latter's works.

I have not translated the brief laudatory poems which follow the title-page by Bernardino Berengario, Romulo Amaseo, Count Andrea Bentivoglio, and Domenico Fonteio of Brescia (who also adds a short piece in prose), and the salute to Lorenzo dei Medici, duke of Urbino, by a certain Achilles Phileros Bochius. Giuliano Signio of Pistoia, surgeon and lecturer in the school of Santa Maria Nuova (which became the university) at Florence, added at the end of the book a table of the bones of the head according to Hippocrates useful for detecting hidden lesions.

TRANSLATION

Greetings and Farewell to the Reader

Lo here, studious professor of the arts, is the work on the fracture of the skull which I have put together in less time than it takes to tell it. If there is anything discordant to any one's ears in its harsh and confused manner of composition let him realize that he is about to inspect a two-months' crop of grain. For who would dare to insist that the glory of such a result is equal in perfection to the speed which produced it? I was choking off on this side my obedience to the desire of my illustrious duke, on that side the assiduous requests and urgings of my students, and was thus like a hysterical woman or one about to miscarry or just like the bitch in the adage eager to give birth whose pups are born blind. On the other hand, should any jealous person twist his rhinoceros-like gaze upon me, let him avert his spiteful eyes, let him burst with his own envy. No less should anyone else who may accuse me of having made my harvest of grapes from the vines of other people know that it is the human race, not bunches of grapes, we are speaking of and let him be admonished that there exist many defenders of my miscarried effort against his malevolence or equally of this hodge-podge collected from the vineyards of those who have had experience in vine-growing. Let not my little book cure the rabid reader, for whom I have not prescribed an antidote. In the same manner let him beware of sticking his poisonous tongue into it lest falling afoul of the handiwork of my scalpel it should be cut off. For I submit my work to the scrutiny of a learned judge and solicit the votes of the students of my faculty. The others I cut off.

Farewell.

PREFACE

To the distinguished and most illustrious Lorenzo Medici, most invincible duke of Urbino, greetings.

Most illustrious prince, it is well known that it is no less regal than humane for the emperor himself and for other very exalted men as well to accept with joyful countenance gifts however small than it is for them to bestow the most precious gifts in return. Pleasing to Jove were the offerings of milk from the Cretan shepherd. Accept therefore the gift of this little book on the breakage of the continuous surface of the head which I have elaborated to the best of my powers and dedicated more than justly to your name as indeed I promised you at your clear request during the time I spent healing the wounds of your head. The physicians of this age will owe you as much gratitude as this book will bring them of usefulness and in like manner will be obligated to render your highness their praises repeatedly intoned. Certainly, whatever the value of this work, it has clearly been created by your admonition and urging as the offspring of my talent. In this respect I shall think I have also satisfied myself if my labor (as I feel without mistrust) shall serve to draw men who are not undistinguished away from vulgar errors by no means commonly known, men whose ignorance has destroyed very many people. Let these men therefore speak to this fact. May you remain healthy and happy as the phoenix for a long time.

Farewell.

When I returned home to Bologna from my medical care of the most noble duke of Urbino, a return than which nothing was more pleasant, I gathered together those students who for good reasons were the most friendly to me. With much give and take they questioned me about the state of his health. That day was spent in a discussion of cranial surgery. When I went to bed, tired out from my journey and because I had passed many sleepless nights, I slept more soundly than usual. I believe it was due to the conversation with my friends that the following dream came to me, for it often occurs that our thoughts and discourse while we are awake cause to appear in our sleep something of what was thought or said, as Cicero says in the *Republic* (6.10.10) concerning Homer on the authority of Ennius about whom the latter was accustomed very frequently to think and speak. There appeared to me in my dream a certain person whose hat was topped by a rooster's crest, decked out with winged sandals of gold and bearing a golden wand in his hand around which a serpent was coiled. He was quite recognizable to me in that form as a third Mercury. I know that a rooster, his crest, winged sandals, a golden wand, and a serpent are the attributes of a physician for antiquity regards a man of such a form to be a consummate physician. Armed with this knowledge I approached this dream- figure without trepidation. But he said: "Do not fear, and offer me your open ears for the time being. To your students who have asked you for it, O how many times, you promised a treatise on fracture of the cranium but up till now you have not given it to them. Whatever you give them will not be taken away from you. Remember that a multitude was fully fed with small loaves of bread and an abundance of fragments was left over. Therefore keep your promise since they praise you as a man who keeps his promises, so that their prayers may not be turned into a complaint, for often a vociferous demand from a beggar is accustomed to bring him success. Impart the fruit of your labors therefore to your friends. Now unclench your hand and you will receive a hundredfold return if you do not disdain to share your knowledge with your thirsty and hungry friends. If you do this you will live forever, for it is by the virtue of our learning that we live. All other goods are momentary and fleeting, the playthings of fortune. That virtue, however, is a constant, eternal, and certain possession. I wish you to observe this: whatever you intend to say, forge it in your furnace and beat it out on your anvil: then it will be made yours. It will become even better than it is now. I know you are not ignorant of the fact that from the same mass of marble Phidias made one statue, Lysippus another, and Polycleitus another. Begin therefore, do not despair, and mix the new with the old. If you do this properly people will discover its worth. Those were real men who discovered medicine, nor should you be disturbed by that trite and vulgar saying: nothing new can exist or be said. Begin then and first meditate alone in silence and hide your meditations in the cloisters of your memory. Examine your purpose from all sides thoroughly. Then proceed slowly to take up your pen without resort to authority or witness. Let your meditations be brought forward that you may listen to yourself not as an author but as a judge. Call your ear and your mind into council and consider what you are and what you will say as if your enemy were dictating your words and whether they should come into the hands of your enemies. Whoever attempts to climb a little higher will find many enemies. You see how great a danger it is to write; but nevertheless you must write and must write in such a way that those who have snapped at our words may find them firm, glowing, bristling, hard, and prickly so that with broken teeth they may understand that he said the truth who declared that envious men are nothing other than a torment to themselves, and they will admit that this saying is a ripe and royal truth." The figure then flew off into his own world, and I awoke from sleep. Thinking over my promise on the following day I decided to fulfill it. Taking up my pen, I intend to publish my treatise on cranial fracture to the full extent of my talent and powers, and whatever I have sought out and approved by experience and reading in the manner of the bees I have brought together. For the bees wander about and gather from the flowers food which they place in order in the honey combs and change the varied juice they collect into one flavor by a certain mingling and property of their spirit. Nevertheless I declare and swear by heaven that I have compiled this treatise according to nothing but the request of my leader, the duke, and by the force and effort of the many entreaties of my students and especially because it is quite easy to hand down medical directions in writing or in speech. At this time, in putting together books as far as the greater part of them is concerned there is only one task, that is, to liberate them from the faultiness of the ancients which is abundant in them and to ask the counsel of the men of our time in what way I can. It is something great, indeed, almost divine, to take the opinions of experienced men into consideration since the smaller part of medicine may be found in books, as with the prince Avicenna in his *Canon,* I, 1. For many of the best and greatest physicians are found to be brief with word and pen, but few, and of these the very fewest, are found in their books. I consider of great value in a physician that clear and orderly judgment which cannot be written down with a pen or expressed by the tongue: hence arises honor, hence labor, hence gather the grain. Not therefore stirred by glory but in observance of the wishes of my friends have I undertaken this task. Nor does the lack of books urge me on but in this part of the work the various methods of the writers. I have avoided errors as much as I could. I admit I could have made mistakes. Celsus (*De Medicina* 8.4.8) says that people of superficial talents who possess nothing never belittle themselves. The great Hippocrates admits that he was deceived in the matter of skull fracture. I have tried to mingle something new with the old for I know that what has been discovered does not stand in the way of what must be discovered. Accept therefore these my lucubrations, O you well-wishers and friends, which I have written down not for those who are envious and ignorant because they are unworthy of my fellowship but for friends and those desirous to learn and as a remembrance in my old age, submitting myself always to the correction of my elder peers. Nor will my discourse be brief since that which is handed down in actual practice cannot be declared in a few words. Let those who are more learned therefore spare me because they themselves were once inexperienced and because of this let them be patient and without irritation if I elaborate my theme somewhat at length for younger people and if also something which the physician does not require may be inserted here. Let this be the fault of an honest leisure and drowsiness on my part. But also before I approach the task I have set before me I intend to preface it with the conditions of the legitimate physician. First, he who wishes to be called a legitimate physician should possess the ornaments or insignia of Mercury which he has earned with labor, watchfulness, and sweat. Thus he will have become the divine physician who according to the testimony of Theodontius flourished among the Egyptians where he distinguished himself remarkably in many forms of knowledge and especially in mathematics to such an extent that he was extolled above all others since on account of his excellence in the aforesaid branches of learning he had merited the name of Mercury, who earlier on the testimony of Leontius was called Hermes or Hermias. He devoted himself to medicine to such a degree that he became supremely proficient in this study and while he retained the name of Mercury he was also believed to be Apollo and being very widely instructed in all of the sacred lore of the Egyptians he became the object of great admiration. To this Mercury alone all the aforesaid distinctions are given but what these insignia signify must be observed since they may demonstrate one thing in the planet Mercury, another in the rhetorician, another in the merchant or thief, and yet another in Mercury the physician. Therefore he is said to be covered with a cock's crest so that thereby we may understand the sky. Even if all of us are covered by it the sky should be recognized most particularly as the province of the physician. By speculation on the various movements of the planets and the dispositions of the stars he can recognize their influences upon the human body, the causes and opportune remedies of many diseases and indicate those things which are necessary for the health of his patient. The physician should also know that he is considered to have knowledge of everything under heaven concerning the elements and what is in them and how they are constituted, what proceeds from them and whether they come from animals, plants, or minerals. The physician is also covered with a crest so that all he does when there is need may be hidden and secret. The crest also indicates that the physician must be constantly vigilant like the rooster for every good negotiator or business man is always alert and arises at cock-crow to carry on his affairs. They say that the rooster is as it were a posted guard from whom the time of cock- crow, or before dawn, is taken. The cock is also said to have been given to Aesculapius by the testimony of Socrates in Plato's *Phaedo*, where he says: "I owe a cock to Aesculapius. Pay him and do not neglect it." Some say that the cock was given to Aesculapius because the physician who is interpreted to be Aesculapius should foresee what is, was, and soon will be. Some say the rooster's crest is suited to the physician because by means of his vigilance he bends his course toward the stars, flies to them, and becomes immortal just as Mercury and Aesculapius were. The physician should have winged sandals so that by them we may know he must fly to the resource of contingent remedies lest his patient die before he arrives with the diagnosis of a physician who comes too late. Let him furthermore possess winged sandals so that the physicians themselves may realize that they minister along with the help of nature and thus laying aside every other care they must fly to the assistance of those who call for their services. Let there be in addition the wand given him by Apollo, the author, inventor, and parent of medicine, that is, to the skilled and learned physician, with Apollo's approval, without which no one, by Hercules, ought to exercise such a function. It is said that with this wand the physician calls the pallid soul from Orcus so that it may appear that many who are about to die already are kept alive or rather recalled from Orcus by the judgment and art of many healers with the assistance of a knowledgeable physician. Thus in turn as long as the causes of diseases are not recognized by this same wand, that is, by an authority or artifice less fitly applied, souls which might have survived are sent to Tartarus, that is, to death. Also by the use of this wand or art the physician puts people to sleep who often are not able to go to sleep and removes the danger from those who sleep too much. The physician with this wand also stirs the winds while he removes the foolish opinions of his patients by persuasion and true reasons. Thus he removes their fear as well as the flatulence which causes severe pain in the viscera of the patient by his potions or other means and reduces it to nothing. Thus also just as the clouds sail by the physicians with this wand draw forth the superfluous humidities from the body, as though they were swimming, that is, drawing the humidities to themselves from the patient. They say that the fact this wand is coiled around by a serpent is to be understood as the practice of medicine with prudence and natural discretion lest it tend by chance no less toward destruction than toward salvation. I say the gold wand is appropriate for the physician so that he may hold the scepter and complete dominion over his patient and those who stand around his bed because otherwise the sick are not healed. For dominion must be measured and involved with prudence just as the serpent is coiled around the wand. That physician therefore who is endowed with such ornaments and conditions will be regarded as another Mercury, Aesculapius, or Apollo. Having first implored the aid of the supreme Workman without which no beginning can be properly established I approach my proposed task.

TREATISE ON THE FRACTURE OF THE SKULL OR CRANEUM PUBLISHED BY CARPI

PART I

The person who is about to discourse on the broken continuity of the head should in proper fashion take up the head or pot (*testa*) or skull, which is the same among the Latins, or cranium among the Greeks, corrupted from cranyon, which is the same as "that which contains and is hard," such as the head which more correctly should be called cranium. Cranium is said to be from *cras*, which is head. I shall divide this treatise into two principal parts.

The first part will concern the causes from which come the names and the types of the broken continuity.

The second part will concern symptoms or signs and prognostication or judgment containing in itself a reasonable cure.

Chapter I

The broken continuity of the head has two causes, one intrinsic, the other extrinsic. I propose to say nothing or little about the first cause. The second is threefold so that there are three distinct types. The first type is from a cutting object. The second is from a pounding or contusing object. The third is from an object which perforates. Thus there are three causes which physicians call primitive or originative. Thus there will be three forms in all of broken continuity, with three names from which particular forms descend. I shall discuss these more fully later. The first is called incision, the second contusion, the third perforation. [cf. Celsus, *De Medicina* 8.3.11: *fracta, fissa, forata, collisa*].

For the understanding of these I note that in Galen, *De Ingenio Sanitatis* [*Methodus Medendi or Megatechnee*], Book IV, it is said that not by one name only is the uneven breakage denominated if the wound is in the flesh or if the fracture is in the bone. Thus many names are used. In Haly, *Theorica,* VI ['Ali ibn al-'Abbas, *Liber Totius Medicinae,* Lugduni: Jacob Myt, 1523] three forms of broken continuity are distinguished. The first is called particular from its nature because some breaks are similar, some composite. The second is from either a simple or composite breakage. The third is from the special difference of breakage, such as large or small and that sort.

Avicenna, *Canon* I, fen II, doctrine 1, chapter 4, p. 16, says a breakage of continuity has many forms, such as wound, ulcer, fracture, opening, disruption, scraping, contusion, separation, rupture, and so on. In the same book, p. 38, chapter 16, he places the differences of broken continuity according to efficient causes. He says the extrinsic causes are such as extend the body, as a rope or weights or that which cuts, such as a sword, or what burns, such as fire, or pounds or crushes like a stone, or what perforates like an arrow or similar objects, or what bites like a snake or a dog. But since I often see the aforesaid authors and all others abusing the aforesaid names for broken continuity, placing one for another, I shall not be concerned about names, especially since I shall discuss the subject at length elsewhere.

The *differentiae* of a broken continuity will be taken up by me in reference to efficient causes and will draw their names from that source. Although diverse causes may create diverse forms of broken continuity also in the head, such as burning with fire, serpent bite and that of other animals, destroying the continuity of the head's surface and bringing the evil effects of poison to it, I intend to say little or nothing of these causes. I intend to speak only of incision, perforation, and contusion in which finally a lesion of the cranium and its adjacent parts takes place without fracture of the skull. This will result for the greater part of my discourse, however, by chance since the title of this little book concerns the fracture of the skull and the parts adjacent to it.

Since therefore I have applied three names to the breaking of the head's continuity according to its causes, the first cause is by cutting, the second by contusion, and the third by perforation. We must now examine by definition the essential nature of each of these.

I say therefore that incision occurring in the head is a breakage of its continuous surface of slight extent made by a cutting instrument such as a sword or similar object, which insofar as it affects the bone should be called a fracture but assumes its name from its cause. Contusion is much more frequent and is made by a blunt instrument such as a club, stone, or such like which breaks and lacerates. It is more truly named a fracture if in the process the bone is struck or clearly broken or folded up (depressed) because not even a fold in the skull is without some fracture although it is deeply hidden from view especially, however, in a dry body. Those who seek the deeper part will investigate it thoroughly.

Perforation, which is of slight extent, is made by an object which perforates, such as a dagger, arrow, or similar things. It draws its name from its cause.

Different names for broken continuity in the head are found written by many people. They can all be placed under the aforesaid terms. Dispute concerning them avails little or nothing in the cure of the ill they represent. Nevertheless, in order to satisfy the younger generation I set forth these forms more in detail. First, an incision of the head which is small and does not penetrate to the inner covering of the cranium, or if it penetrates it is nonetheless superficial and without lesion of the membrane, can be called capillary. Its cure proceeds just like the cure of a true capillary made by an object which is used for pounding as I shall describe in its place. This is called by Haly, *Practica*, Book IX, chapter 4, *ragamia* and in the *Pantegni* [or *The Perfect Book of the Art of Medicine*]. In *Practica* IX, chap. 97, it is named *darca* or *rhagamia* from *rhagis*, that is, rupture. Another form is that in which the bone is cut into superfically with the removal of the first or external surface of the bone which Haly, above, calls *aberia*; in the *Pantegni* it is called *angin*. There is another form in which the entire bone is removed as far as the membranes. This is called *apostatimos* by Haly as well as *cutomatos* and *apostatimos* in the *Pantegni*. This form Abulcasis calls axialis because the ax is the instrument used in this way on wood (p. 194). I should believe that *aberia* or *angin* could more truly be called *axialis* because carpenters working with wood move the ax only on the surface of the wood. However, I do not wish to waste time on this matter. There is another species in which the cranium is broken into many parts and the lesion descends to the membrane below the healthy bone. This is called *empyasma* by Haly, *antiaca* and *empyasma* in the *Pantegni*. Another mode of rupture is given by these sources which is similar to this to which I do not care to give a name. There is another form in which the bone is broken but more deeply toward the membrane. This is called *marusis* by Haly but *monesis* or *marusis* in the *Pantegni*. I believe this form is a folding or doubling up of the bone wherein it is folded and broken to the interior only and not to the exterior. There is still another species in which the bone is depressed toward the interior as happens to a pliable or malleable vessel when a hard body strikes it and makes a dent. This happens to soft bones such as those of children. This is called *haesena* by Haly and is said to be a folding without fracture of the cranium. In this species I believe some fracture does occur but it is hidden and the body may be soft in its way especially within the bone itself.

I wish to inform the reader that earlier I adduced the authority of Haly in his *Practica* IX and the same source in the *Pantegni*. Note that *Pantegni* was composed by Haly. However, the title of the book was changed by Constantine the African, who in his translation of it [*circa* 1180 A.D., from Arabic to Latin] ascribed it to himself, with some parts of Haly's book changed. [Haly's book is also called the *Book of the Royal Disposition* (*Liber Regius, Regalis Dispositio, Kitab al-maliki*, Venice: Nigro, 1492: Klebs no. 498).]. But recently a young man named Symphorien Champier says the *Pantegni* and Haly's book which are the same with a few changes are by Isaac Israeli. He says that Isaac himself in his book on fevers refers to the *Pantegni*, which is true, but I believe this is another *Pantegni*. Since Champier states that Rhazes quotes Isaac in the *Continens* therefore I say that this work is not by Isaac because Rhazes lived before this work was written as appears in the introduction to the *Book of the Royal Disposition*, where among other physicians who existed before Haly Rhazes is praised. For this reason I hold that this work, the *Pantegni*, is by Haly. I also see that many great learned men adduce the authority of Haly and it would be foolish to believe one man, Champier, against so many and such great men. I therefore contradict him on the basis of the aforesaid facts. I have another reason for my view: Rhazes, *Continens* XV (i.e., *Liber*

Almansoris quoted by its short title, adduces the authority of Isaac on the extraction of arrows with the remedy of a frog placed on the wound. But when in the ninth chapter of the *Practica* quoted in the *Pantegni* the method of extracting arrows is described in a very ample and excellent chapter nothing is said about a frog. Therefore I say that the statement by Champier, i.e., that the *Pantegni* is by Isaac, is untrue.

I find furthermore other kinds of lesion in the head which lack special names. One is that which occurs when although the cranium is not fractured some nerves of the brain are ruptured or some veins in its membranes by a strong movement or a fall and percussion when a heavy, powerful object moves or shocks the brain, especially in a dry body such as that of old men in which the brain is more easily moved and broken because the marrow is dried and diminished, as father Hippocrates says in the sixth book of his *Aphorisms* commented on by Galen, commentary 58. For some people, when the brain has been shocked by some action they become speechless immediately, as I witnessed this year (1518) in his excellence Lord Ercole dei Marescotti, who had suffered many contusions from a heavy object and yet had no cranial fracture. He finally died in spite of every effort exerted by his physicians. I do not say this tragedy happened only because of the rupture of the nerves of the brain because the people who suffer damage to the nerves from which arise the reversive nerves, which are the nerves of the voice, become voiceless, but because I believe some small vein of the brain in his case was in itself ruptured and probably some nerve as well. Death was brought on by this vein on account of the blood which became putrefied there in an unknown location. This form of lesion is serious and fatal because physicians do not know the location of the vein. If they knew they could open it and purify it of the blood and pus and thus heal the patient. Celsus (8.4.7) among others holds this opinion of the veins in his chapter on the cure of the skull in these words: "Sometimes, however, it happens that the bone at any rate remains intact within but from a blow some vein in the membrane of the brain is ruptured and emits some blood, etc."

I have seen another species of lesion in the head three times in my medical practice. Physicians have been deceived by it when the bone is not fractured sometimes by a heavy object which strikes it or by a fall from a high place. Part of the cranium, anterior, posterior, or lateral, struck in the part opposite to itself is so affected that one suture strikes that near it and even one far off, I might say, or quite far off, because it is possible that the frontal bone pushes the bones of the *bregma*, among which the sagittal suture is found, in their middle. The sagittal suture pushes the lambda bone, and from whatever suture there pass forth the *villi* of nerves. The *dura mater* conjoined to the pericranium and some vein and hence nerves and veinlets and the membrane itself are pounded between two bones. Then in the course of time they putrefy because every part which is contused must putrefy and be converted into bloody pus. Then come fever and other incidental ills, finally death. Physicians are doubtful about this matter and some of them believe that when contusion takes place in one part there is also a fracture of that part or, failing that, there is a fracture in the part opposite by reason of the appearance of bloody pus in the opposite location without a break in the skin because where the membrane is squeezed or crushed and contused a swelling is created from the suture in that place by the pus and a collection of it is created, as I have seen three times in dissecting heads although I found a soldier who had fallen without fracturing the bone opposite. Or shall we say that the bone can be ruptured in the part opposite to its location? Let this suffice concerning the forms of broken continuity, which can be almost infinite in respect to their cause since some are large, others middling, others small and of different kinds. All of them can be reduced to the aforementioned species, especially by those who are competent judges and shrewd in their reasoning; without these qualities let not anyone approach this art of medicine.

I have said something concerning the names of these species for the benefit of the young not because my purpose lies in this direction but that in the process of healing I intend to set forth many things. Hence thus much in reference to the first part of my treatise, having examined the forms or species of broken continuity, their causes, and their names, I must now pass to the second part.

PART II

Chapter I

After they have determined the nature of illnesses, their forms and causes, physicians are accustomed to speak about their signs or symptoms and then to deliver their judgment or prognostication and finally their cure.

I shall first speak of the symptoms since physicians come more easily to a recognition of broken continuity in the head made by cutting or perforating objects as to whether or not a fracture of the skull and lesion of the membranes and brain have resulted than from objects which make contusions. This fact is in accordance with reason and experience.

Some of the symptoms signify cranial lesion only. Some indicate lesion of the membranes by abscesses, some show pus flowing down and weighing upon the membranes or the brain. Others show a pressure or a puncture upon the brain or its membranes. Some show that a hard membrane is separated from the cranium. These are the signs which I propose to describe at present for younger men in recognition of the species of aforesaid lesions.

Let us begin therefore with the signs of cranial lesion. We say that some signs are presumptive and some are manifest to the senses. The presumptive are these: redness of the eyes, bilious vomiting, loss of speech, falling to the earth at the time of the heavy blow, and stupor of mind. These signs occur without fracture of the bone. Nevertheless, they can occur due to the motion or concussion of the brain, as I shall describe in its proper place. "Even if none of these symptoms appear one may doubt that the bone has been fractured because they do not necessarily accompany the fracture of the bone. It is reasonable to believe that considering the nature of the pounding object, stone, wood, or iron weapon, whether the blow is of gentle, harsh, or middling in force, and made by a heavier object gently or more strongly, the gentler the blow the easier it is for the bone to resist it" (quoted from Celsus, 8.4.2).

The manifest signs of lesion are not presumptive but actual and can be verified by touch or sight, as Celsus says (ibid.): "Therefore a probe should be inserted at the location of the wound, not very fine nor pointed, so that when it descends into some natural sinuses an estimation of the fracture of the bone is frustrated. Nor should the probe be too thick lest small cracks lead the physician astray, for when the probe reaches the bone and nothing except what is smooth and slippery is met with, it can be seen that the bone is intact; if any roughness is met with, at least where there are no sutures, it is a sign that the bone is fractured. Hippocrates testifies that he was deceived by the sutures in the matter of skull fracture" (*Epidemics*, V,27,28 Littré).

Haly says on signs of skull fracture: "The recognition of any skull fractures arises from the nature of the object which strikes the cranium, its weight and hardness, the force of the blow and from its results, such as impaired vision, loss of speech, or a sudden fall. The examination can also be made when the bone is exposed, especially if the break in the skin is large. If the break or fissure is small you may determine the situation by careful inquiry using an instrument such as a probe. You will recognize the fracture from the sound itself made by the instrument because it will be indicated by a clearly hollow or hoarse sound as has been said above."

Note, reader, that every kind of fracture is easily recognizable except the capillary fracture and that form of it called *marusis* by Haly, in which the bone is folded or depressed toward the interior and is ruptured in contact with the *dura mater* but not toward the pericranium as sometimes happens in dry wood or in some other material which is clearly broken inward and where the break does not appear externally except by a diminished compression inward. This happens more often in a dry body, whether dry because of age or by complexion or by both causes. Thus sometimes a splinter of the bone punctures the membrane and sometimes does not puncture it, but on the inner surface of the cranium the fissures are more visible than on the external surface because sometimes nothing appears on the exterior. This situation is to be feared among others because the physician only with the greatest difficulty is able to determine this form of lesion especially by sense but only by a presumptive judgment after having seen the symptoms which accompany it, that is, impaired vision, vertigo, fever, vomiting, redness of the eyes, and such like. Then there is added the recognition of the original cause as previously stated according to the opinion of Celsus and Haly, whose opinion many others have followed, and rightly too, especially our prince, Avicenna, *Canon* IV, fen 5, tractatus 3, chap. 1, p. 460v: "The point at which one turns away from opinion to accurate fact and then to conviction rests upon the consideration of the cause of the fracture and the assessment of the force of the impinging object as to its weight, size, and strength. In this way the true apprehension of the situation will be reached. The accompanying symptoms similarly will sometimes indicate a fracture, that is, loss of vision, voice, and similar ills." He emphasizes the fact that sometimes not even an expert can always determine the truth.

Note that occasionally the cranium is ruptured but not the skin. The physician cannot thus identify the place of the fracture until the patient himself touches the spot from time to time, as Avicenna says: "The patient often indicates the spot and touches it at frequent intervals, especially when he is unable to speak. This occurs particularly in the case when the bone is broken or punctured or weighs heavily upon the membrane of the brain" (ibid., p. 466v). The patient himself touches the place in his pain, a natural action. This well-known fact led Avicenna to list touching by hand as a sign of lesion, whether the patient is in a state of reason or not. Not only does he touch his head but he moves it this way and that and finds pleasure in this. Whether such a movement is natural or voluntary I shall explain elsewhere.

But because I said above that the skin is not broken while the cranium is broken you should understand that the skin is not visibly ruptured because the rupture is hidden since it is contused and broken over a large area yet not manifestly so. Moreover, I do not wish you to misunderstand and to believe that the skin is often divided and broken into small parts but because it is viscous it remains joined together and does not appear broken especially to the eyes of unskilled observers.

There are other signs of fracture which have been written down by more recent writers. For instance, let the patient take a waxed thread between his teeth and let another person hold the thread with his hand and then when the thread is taut let him break it with a stick or some other object. If the patient feels pain in his head especially in the area of the lesion, they say the bone is fractured if he cannot bear the shrill creaking or gnashing sound made by the vibrating thread. Some say that the bystanders themselves cannot bear this sound because there are some people who naturally cannot tolerate such an experience. Some say that he alone who holds the string in his hand cannot bear its sound. But I believe if this sign has any truth to it that this should happen only to the patient. Some seize the thread in their hand while the patient holds it in his teeth and they yank it violently and frequently. If pain is thus caused as previously said they say the bone is fractured.

Some give the patient an almond, hazelnut, or other kind of nut to try to break in his teeth. If this causes pain in some area they say that area has a fractured bone in it. Or they bid someone to pull tightly on a knot of straw and to try to break it or at least to pull it more tightly. If he cannot do this they say the bone is fractured. Among other signs Lanfranc [*Chirurgia Guidonis de Cauliaco*, Venice, 1519, f. 175 a, where he is quoted; he wrote *Chirurgia Parva*, trans. John Halle, London, 1565] lists the following two in his chapter on skull fracture as more trustworthy than others. If when the head is struck with a dry light stick and it sounds hoarse and hollow and when a waxed string is drawn or plucked with the fingernails high up and held there it makes a shrill sound, as above, there is a fracture.

I have tried all these methods and have little faith in the signs they indicate. I have seen many men break the shells of nuts, hazel nuts, peach pits, and almonds without pain and yet they had a large fracture of the skull from which some of them died. But I believe these experiments cause pain if the fracture lies near the place where the muscles of the jaws are attached. When these are partly injured they cannot well move the accustomed members. Thus by simply masticating food men feel pain in some part where the muscles are injured or pus has flowed in and because of the wound or contusion has collected more of it, thus impeding the free movement of the muscles and consequently the movement of the jaws, as is clear to a good anatomist who knows the location of the aforesaid muscles. I should not believe that the shrill sound made by a thread is a true sign because as I said above there are many people who by their nature cannot endure the sound of gnashing teeth unless inquiry is made beforehand as to whether or not this experience is accustomed to be intolerable for them.

There are other signs which teach us to recognize if a capillary fracture penetrates the entire thickness of the cranium. The first is the application of black ink upon the fissure and for the operators to see where the fissure ends. This is an effective and a true, indubitable sign. Another sign is the following. With closed mouth and nose let the patient make a total effort to propel air from his chest to his head. If the little crack penetrates you will see something coming out of it. Another sign: take some pulverized mastic and the beaten white of an egg. Mix them up until they have the consistency of honey. Place this mixture daily over the affected portion of the skull in an area large enough to cover the bone in question. Then if the fracture is penetrative the mastic directly over the fracture will be drier than elsewhere. This is the recipe of the great Guido [Guy de Chauliac] and also of Niccolò da Firenze (or Falcuzzi, d. 1412) [*Sermones Medicinales*]. But Leonardo Bertapaglia (Bertaglia) [first half of the fifteenth century at Padua and Venice] in his book on skull fracture (in *Collectio Chirurgia Veneta*, Venice, 1498, 1499: Klebs no. 494) makes two plasters which he applies to the head with which he recognizes a cranial fracture even if the skin is not broken. One is this recipe: take three ounces each of incense, wax, and laudanum. Mix and apply for a day to the shaved head; where the bone is fractured there the skin will become dry. Another plaster is this one. Take one pound each of wax, incense, laudanum; of turpentine, vinegar, and bean flour, one-half pound each. Make a compound of these substances and apply to the head. Where the cranium is fractured you will find the plaster over the perforated part diminished and drier.

For the sake of dispute against these men I say, first, that either bloody pus has not yet issued from the fissure because it is not able to do so or even if there is no penetration of the fracture some hot vapors can issue directly from the fissure which dry the mastic placed over that fissure, especially if fever exists in the patient and so the mastic in the region will be drier. But if there is some bloody pus under the bone it will be drawn forth by the drawing force of the mastic through the fissure and thus in the direction of the fissure pus or some humidity will become present. Hence this sign can be deceptive unless it is subjected to careful thought.

One must therefore in whatever form of fracture consider many signs and not one alone nor be contented with a few but with the majority of them where the physician can ascertain the situation not only with a probe or a sound but by touching with his finger, wherein lies the true sense of touch. Thus as the physician approaches his patient, whether the skin is broken or not, or broken quite considerably, whether or not the cause is known, if the case is serious he should immediately open the skin to the bone triangularly or in a quadrangular fashion so that he may recognize the facts without which knowledge patients are not cured. If he postpones this task until later due to the disobedience of the patient or by chance the timidity of his attendants or for some other reason the physician does not dare to open and lay bare the cranium, another physician may arrive on the scene and take over properly in the former's place. Since the injury is critical, perhaps so critical that it does not allow for delay, the wound should be opened as quickly as possible. I urge that this be done in the first hour because in that period the patient has little sensation for a reason which everyone knows, also because after opening the wound the physician can operate freely and conveniently and the illness will not be prolonged. If he does not do this death will likely result, as often happens. Not only should the physician be careful and swift in operating on the head but on all other members since if such an operation is postponed although other remedies are applied they will be of no avail if such a preliminary operation is judged necessary. As Galen says in *De Ingenio Sanitatis*, V, 15, such physicians resemble a ship's captain who is negligent with his ship until it is wrecked. Then he gives each sailor a plank and orders him to help himself with it as far as he can to avoid death. Mesue sums up this idea when he says: "O you who cure bodies, do not postpone all help because once the patient is dead no assistance will be of value."

Therefore let the physician operate boldly and lay bare the cranium since no harm will follow upon this stage in the proceedings. The way is opened for operating with whatever procedure you wish, by trepanning, chiseling, and extraction of bones and the performance of whatever procedure. For the skin of the head has little feeling except in the lateral parts and the front of the head in which there are notable muscles. If this skin is cut there is little harm and it heals quickly, as Celsus says (8.4.7) on the cure of the skull: "Even if it is uselessly incised, the scalp heals without much trouble."

It is therefore safe to cut the skin and lay bare the cranium where fracture is suspected and also in front and at the temples if necessary, but with care, lengthwise of the muscles. The health and strength of the patient must first be taken into consideration above all else. Nor should anyone be rendered bold and reckless by my words but let him lay bare the cranium with measured deliberation. Let this suffice as far as the signs of skull fracture is concerned. When I speak of a cure I shall also describe the method of cautious procedure in the skull and inside it, with the assistance of Him Who is three and one.

Chapter II

Whether a Head Struck in One Part is Broken on the Opposite Bone

Before I proceed further there is doubt whether a cranium which has been struck a blow can be ruptured in the part opposite to the site of the blow. I find different opinions on this point. Celsus in the passage referred to holds the affirmative view and expressly says so: "It may even happen that the blow may have been upon one part of the head and fracture at another. Thus if anyone has been heavily struck and bad signs have followed and no fissure has been found in the part where the scalp has been wounded, it is worthwhile to examine whether some other part is softer and swollen, and to lay it open; then perhaps fissured bone may be found there" (8.4.6.)

Many other moderns are of the same opinion, that if the cranium has been struck in one part there exists a fracture opposite to it. Among these is Niccolò da Firenze (*Sermo* VII, tract, 4, chap. 50-54; Venice, 1491), who describes a case history of which he was a witness, a certain rope maker who had been struck with a nail in the right temple. An opening was made but the cranium was not fractured in that place. On the twentieth day thereafter the patient contracted rigor and fever but on the twenty-second day a lividity appeared at the opposite temple. The flesh had mortified in that place. When this flesh was removed the cranium was found to be fractured. The patient died, however.

Note that the aforesaid opinions do not deny that if the cranium is ruptured in the area opposite to the place of the blow it can also be fractured in the place where the blow was received because if it is conceded that the opposite bone is fractured so much the more is it possible that the place which was first contused is also the site of a fracture. This is clear to any ingenious and experienced person.

I find opposing opinions, according to which when the cranium is fractured in one part it cannot be fractured in the part opposite. The basis for all these opinions is laid by Paul of Aegina, *Chirurgia*, Book VI, whose opinion is recited most subtly by Dino de Garbo and Gentile da Foligno, explaining Avicenna on skull fracture, *Canon* IV, p. 466-7, whose words have been quoted above.

Guy de Chauliac is also of the same opinion and many others. Gentile, however, hesitates, saying that he has a contrary view based on sound authority. The reasons given by Paul of Aegina are these: The cranium cannot be broken in the same way as a glass vessel or a dry gourd because the cranium is not so fragile nor so dry as the latter nor so empty but is harder, more solid, and filled with the brain. More than this, and a reason stronger than the others, it is not a continuum but is divided by sutures which are distinct and separate. This reason concludes with the fact that from one suture a fracture does not extend beyond to another suture. This is clear to anyone with experience in the matter, that whatever part of some contiguous body is struck the injury does not cross over from part to part but the breakage remains in one part only.

Therefore, having seen the contention and controversy among so many people, it is not up to me to settle their dispute, but I will say what I think about it.

First, I say the authority of Celsus is great and he should receive credence because he is the most ancient author and of great weight. After Hippocrates, he is among the first. In his time a different kind of medicine was practiced than in our times, especially in surgery, as our Rhazes and Averroes and great Abulcasis testify. They say that a greater share of surgery had perished and lay prostrate in their day. Before them there were very good physicians whose names are listed in this art partly by Celsus (7.1) where he discusses the requirements of a surgeon. Those who distinguished themselves in the time of Celsus were top-notch surgeons. Although surgery was in the hands of fools in the time of Avicenna, Rhazes, and Averroes, nonetheless the latter did not disdain to treat the subject along with drink and diet, for these are also required with surgery and vice versa. In turn, Galen, *Introductory Medicine*, chap. 10, says the curative process in medicine leads to diet, surgery, and drugs, for diet involves diaphoretics, compounds, and the assumption of aids to digestion in all patients, but it dominates in cases of fever. Surgery is part of the cure in incisions, cauteries, and remedies for the joints of bones. Drugs are a part which heal external or internal pains by the use of simple medicines. Sometimes one or the other requires the aid of diet or surgery just as surgery makes use of diet and drugs. Celsus holds the opinion (7, proem 1) likewise. He says of surgery: "It does not omit medicaments and regulated diets but does most of its work by hand. The effects of this treatment are more obvious than any other kind inasmuch as in diseases since luck helps much and the same things are often salutary, often of no use at all, it may be doubted whether recovery has been due to medicine or a sound body or to good luck. Besides, in cases where we depend chiefly upon medicaments, although an improvement is clear enough, yet it is often clear that recovery is sought in vain with them and gained without them; this can be seen for instance in treating the eyes, which after being worried by doctors for a long time sometimes get well without them. But in that part of medicine which cures by hand it is obvious that all improvement comes chiefly from this, even if it be assisted somewhat in other ways. This branch, although very ancient, was more practiced by Hippocrates, the father of all medical art, than by his forerunners."

You see by these words what surgery is and how important it is and in which part of medicine we must place greater credence. But I believe that surgery is postponed because of the work it entails and because few dare to handle what is required by it since the operation involves nausea and abomination. Enough has been said elsewhere and more in detail on this subject. We must believe Gentile when he says he placed his faith in experience contrary to the opinion of Paul of Aegina.

I shall say, however, what occurs to me in this matter. I should place greater credence in Paul, Dino, Guido, and their followers than in the others. Nor do I say that the authority of Avicenna is in their favor when they say Avicenna states that the cranium is ruptured at the point opposite to the contusion. But that authority is closely connected and can be twisted against them, as Dino expressly declares in his comment on this passage of Avicenna, of course. And sometimes a great error is made. It may be thought that unless one understands Avicenna to mean that there is nothing except a fracture since sometimes the cranium is ruptured in some part by a contusion and there is not only one fracture but many fractures nevertheless it is not clear that there is more than one. Thus one must open the contused area since sometimes there are more than one fracture but they are not opposite the contused area and not far distant but some one of them is clear to the sight because of the contusion and laceration of the skin which is of such a nature and size that one fracture appears while near it are some other hidden fractures. In such cases the physician in consideration of the magnitude of the cause of the fracture should operate and he will discover multiple fractures. I have done this in actual practice many, many times and have seen what I have described. Therefore I concur with Dino in his exposition of the passage in Avicenna which has been mentioned. Not only does it happen that there may be more than one fracture but one alone which is sufficiently longer and larger than the fissure made in the skin. Therefore it is best always to widen the fissures in width and length and thus to avoid errors and the reproaches of the physicians who will supervene in the case and bring a favorable conclusion to the illness as far as is possible through medicine.

In reference to the reasons adduced by Paul of Aegina and repeated by Dino, Gentile, and others I add the reason of the dryness and vacuity in glass vessels and in other bodies which he concludes to be facts; although they are full of air they can be broken in the opposite part and in whatever part distant or nearby. But the reason of contiguity implies the complete opposite if true contiguity exists in a flat body or a curved one. But some heads are found which really have a contiguity divided by their sutures. Some are also found which are continuous or almost so as I have seen many times in skulls dried out in cemeteries. There are some in which distinct sutures appear, some in which they are seen with great difficulty. If such heads happen to suffer a heavy contusion I believe and set it down as possible that a rupture can be made in the opposite part. It is true that the slothfulness of the operators is so great that sometimes they mistake one for the other, as I have seen three times. I said this earlier concerning that type of lesion in the head, that is, when the membrane between sutures is contused toward the opposite side and pus later collects in it and a swelling arises. Physicians then find pus and corrupted flesh in that place and a crack of the suture. They then believe the rupture is caused by the first contusion; thus many physicians are deceived because they take small consideration of the situation and know even less about medicine.

It also happens sometimes that someone is struck in one part with a stone or some other heavy object and in that area of the cranium a fracture is not found. It is also possible that he falls to the ground on the side opposite to the blow or strikes his head in the opposite part against a wall or some other obstacle and his cranium is ruptured on the opposite side without breaking the skin. Afterward, or immediately, or in the passing of time this rupture becomes visible. In this situation many are deceived, and perhaps some of those mentioned above are deceived also. I do not deny the possibility, but I say it is difficult and that often the physicians say there is a fracture in the opposite side and what they say is a pure lie because many of them approach this art who are ignorant of the first elements of medicine.

Chapter III

Signs If the Membranes Are Broken

Having observed the signs of a fractured skull I must speak in the second place of the signs of the membranes, if they are cut, perforated, or lacerated or torn from the bone. I shall speak of their abscesses and when they are weighed down or oppressed by the cranium and injured by the pus which flows down to their location.

The following are the signs of injury of the membranes. If they are perforated, cut, or lacerated the head will suffer a severe constant pain within itself. The eyes will hurt with a pain that accompanies the percussion of the head or which will come later. This pain is piercing and steady. A quite active vomiting of bile will also occur. This takes place because of the transfer of pain from the brain to the stomach by means of prominent descending nerves. On the authority of Galen, *De Interioribus* 7, the stomach is affected by the head when the latter is in pain and the head by the stomach through the means of a large nerve which descends from the head to the mouth of the stomach. On account of this nerve the mouth of the stomach is more sensitive than all the members of the body. Thus it always reacts to a fracture of the head which results in a bilious vomit which affects the membranes of the brain. Colic also ensues and a general pain in the intestines for the same reason since all the latter have sensation from the aforesaid nerve. There also follow loss of appetite and weakness of the digestive and expulsive as well as all other bodily functions for the same reason. Likewise, a redness of the eyes appears since the tunic of the eyes arises from the membranes of the brain. Daily fever also sets in due to the pain created by the agitation of the animal spirits in the brain, especially if the head injury is sizable. The fever may occur suddenly and a putrid fever arise as well but not so suddenly due to the putrefaction of some pus either in the veins or outside them, whether in the head or elsewhere. Pustules on the face occur from the humors which arise to it, and blood may flow from the ears, palate, and nose. Sometimes blood issues from beneath the bones, originating from some vein in the injured membrane, and there appears a blackness of the tongue and hiccups, which is a very bad sign.

These accompanying symptoms are greater or less according to the size of the lesion. This applies as well to the membranes since injury to the *pia mater* is more serious than that to the *dura mater*. The location of the lesion is also important for if these membranes are injured where there are prominent veins in the membrane it is difficult to escape harm, especially in the *pia mater*, from whose veins blood issues, putrefies, and creates an ominous symptom. Rarely is the *pia* injured without injury as well to the marrow of the brain because when the *pia* is injured the entire brain suffers since the *pia* is for the greater part made up of arteries and veins. Through these arteries the animal spirits prepared in the marvellous net *(rete mirabile)* are brought down or according to some are made vital. The *pia mater* not only covers the brain on the outside and nourishes it but also enters within its venters through the orifices of its arteries. For this reason there occur obstruction of the reason and loss of vision as well as tremor and rigor in these wounds because the brain is contracted into itself, drawing away from and expelling the harmful effects of the injury. Spasm also occurs although this is caused by pus transmitted to the nerves since spasm results from repletion. Spasm can also result which is not related to pus transmitted to the nerves. Each kind of spasm can supervene in a short time, also with resulting paralysis and excessive pain. Stupor of the members is also due to pus transmitted to these parts.

Note that Avicenna, *Canon* I,3, says that paralysis occurs on the side of the wound and spasm on the side opposite to it as in many cases. Nevertheless I say that the reverse situation can happen, that is, in the injured part spasm can occur while paralysis occurs in the part opposite. Likewise it is possible that only one of these afflictions may occur or neither. But the reason why spasm occurs in the opposite part and paralysis in the injured side is because the part near the wound is weaker. Therefore it becomes relaxed because it cannot be contracted or drawn together but the opposite side can be drawn together.

Another cause is that to the injured part there runs thinner pus which at first moves to the weak part and afterward to the strong. It is thinner and thus more mobile and runs more quickly to the injured part, thus softening it, but the heavy pus causes spasm in the opposite part.

Apoplexy results from the pus which stops up the venters or ventricles of the brain just as the pain of the heart produces syncope, for the heart suffers in sympathy with the brain and vice versa. All these symptoms occur suddenly or almost suddenly if the membranes are injured as described above.

But if these membranes are contused and issue forth between the sutures because the *dura mater* is there such symptoms are weak and arise in some considerable time more or less slowly according to the size of the lesion and the bodies which strike the head, whether these are clean, dirty, heavy, or light and according to the time of year and the age and region of the victim, including his regimen of the non-naturals and the manner of the cure employed.

But the symptoms which accompany the aforesaid contusion between the sutures do not result only from the contusion itself but from the putrefaction of the injured membrane or because pus is transmitted from elsewhere to the site of the injury which when not regulated by nature putrefies and increases in a continuous manner because that which is touched by putridity also putrefies. When it reaches a certain determinate quantity fever and other symptoms supervene. Finally death occurs unless medical aid is quickly brought even though it may be difficult to save the patient, given the facts that the situation was known from the beginning and was such as described above. But diagnosis is so much the more difficult when the injury is hidden from view and this fact is not recognized except by the bloody pus found at the site of the wound for the injury is hidden from the beginning and the physician does not know how to deal with it nor where because he is ignorant of the exact ill involved and its location. The patient is in for much wakefulness and suffering and becomes completely prostrated.

These are the symptoms of injury to the membranes. Sometimes, however, it is of such a nature and so large a fracture of the cranium that the physician not only recognizes the lesions of the membranes by these signs but certifies the fact by sight and touch.

Chapter IV

Signs of Brain Damage

Signs of brain lesion are the same as those described for lesion of the *pia mater*, with the addition that the medullar substance of the brain issues forth although it is possible that the brain may be injured especially by an object which perforates it minutely or an object which strikes it superficially and lightly, however, so that some part of the brain marrow does not issue forth. Nevertheless, in many cases it does issue forth and you may hold this to be the brain if some white substance comes forth which may appear to be marrow since it cannot be anything else but the brain, especially if it comes forth in the first days before the pus begins to form because some people say that sometimes the brain comes out of the wound and this is probably bloody pus. I do not deny that after a considerable time and even when much bloody pus is present the substance of the brain may issue forth because around the thirteenth day I saw the brain's substance coming forth and the patient survived after all.

I say furthermore that these signs described by learned men have truth as I have seen in many cases. Nevertheless, I have seen lesion in the membranes and also in the brain where there was no fever nor any bad symptom, as I shall say at greater length when I speak of prognosis. The aforesaid signs occur when the brain is injured by a cutting, pounding, or perforating object with lesion of the brain and cranium both visible and hidden.

Chapter V

Signs of Brain Concussion

But since sometimes it also happens that the brain is injured otherwise, as I have said concerning the types of lesion of the head, because the brain is struck by a fall from a height or contusion or some other means or is shocked by concussion and some nerves in it are ruptured or some small vein therefore I shall set down here the signs of this kind of lesion.

I say that sometimes the brain is moved and agitated by the aforesaid causes without a break in the skin nor a rupture in the cranium or sometimes the skin is broken but not the cranium and some nerves of the brain are ruptured and along the ruptured nerves there occur different symptoms in the members to which such nerves pass. There are seven pairs of nerves, of which some pass to the eyes, some to the tongue, some to the ears, some to the stomach and some to all the intestines to give sensation to these members or at least to the membranes which cover them and to the liver, spleen, and other members as these are noted in a good anatomical dissection. Galen mentions this lesion of the nerves in his comment on the *Aphorisms* of Hippocrates, VII, 58, as I said above when I was discussing this type of lesion. The sign of this lesion is set down by Galen in the passage previously cited where he says that those afflicted are deprived of speech immediately: "And thus if a patient comes into your hands who has suddenly lost his voice and has been struck by some powerful object the brain is shocked either because the patient has fallen from a height with symptomatic conditions which persuade you that his brain has been shocked even if the skin is not broken or if the skin is broken the cranium is not or even when the cranium is also fractured. Confirm your judgment on this point that the brain can be shocked when you have seen the serious indications of the fact not only because of his loss of speech but because all the aforesaid symptoms can occur although not suddenly. Thus not only will you judge that a rupture of some of the aforesaid nerves has taken place but possibly a rupture of some small vein contained in the membranes."

Chapter VI

Symptoms of Vascular Lesion

The symptoms, however, of a ruptured vein do not occur as swiftly as do those of ruptured nerves, but they arrive at the time when the blood begins to putrefy beneath the bone, later or sooner according to the quantity of blood and according to the location of the wound. If this hemorrhage occurs between the cranium and the *dura mater* the symptoms take place more slowly than if the wound lies between the *dura* and the *pia* and more slowly still when it is between the *pia* and *dura* than between the *pia* and the brain. I shall not recite the causes for this since they are obvious by themselves.

This species of lesion is difficult to recognize. Nevertheless, it is possible to do so especially by experts in diagnosing the nature, cause, and symptoms of the illness. But the cure is more difficult because the physician probably does not know the location of the blood and bloody pus and thus necessarily desists from a reasonable cure. Thus the poor patient dies. The difficulty of the cure is attested to by Serapio, *Breviarium* I, on *soda* (*cephalalgia* or head ache) from percussion; he says: "And when a man falls from a high place by accident so that some part of his brain or the net called *secundina* is broken the *soda* which occurs in it is difficult to cure."

However, if ingenuity is employed in a cure it can be achieved. The entire head should be covered with the required medicines, as I shall say in greater detail when I speak of the cure, because the precise location of the bloody pus is unknown as well as that of the ruptured nerves, as very often occurs.

Similarly, the proper location in many other afflictions of the head is also unknown, according to Galen, *De Interioribus* III, chapter 4. He says likewise that we find no indication for the location showing the injured spot in cases of melancholy, mania, epilepsy, lethargy, and in stupor, which modern physicians call congelation, in spasm and tickling or irritation, in all of which we find no signification as to the cause of the illness, neither hardness, swelling, pain, change in body warmth, nor any effluvia from the body.

Note, reader, that the aforesaid symptoms in the lesion of the membranes and of the brain can be caused by putrefied blood under the cranium according to the places to which it goes and according to its quantity. Therefore you should not be surprised even if the membranes and the brain are not injured but only from ruptured veins or perhaps nerves the aforesaid symptoms arise because many things can happen due to these symptoms even when the membranes and the brain are not injured, especially if bloody pus happens in some way to descend from the upper regions through a little crack in the bone or perhaps it resudes through the porosities of the bone back to within the cranium, especially when the bloody pus does not have free exit from the wound. I have seen this situation in actual practice while dissecting the heads of people who died from a similar accident without a ruptured cranium or some injured membrane. Fever is caused by the bloody pus descending through the pores of the cranium above or upon the membranes. So are rigor, vomiting, hiccups, alienation, and other similar symptoms or accompanying pain of the members below the brain and of the brain in connection with the members due to the bloody pus which corrupts and putrefies them. Finally death follows.

Let there be therefore diligent, prudent, and solicitous physicians because danger lies in delay, and let them not disdain to visit their patients frequently since through a long association with them they can come to recognize their sickness and consequently its cure. Let these words suffice for the symptoms of the brain concussion.

Chapter VII

Signs of the Bad Complexion of Any Head Whatever

In another place I shall have to speak about a bad complexion of whatever kind and of abscesses of the brain and of its membranes.

I say therefore that from contusion, perforation, and incision caused in the head in various ways and at different times and according to each individual, clean and unclean, weak and strong, and according to their regimen both present and past and the method used in healing them there occur bad complexions for the head and consequently abscesses and other symptoms which necessarily accompany these illnesses. These the physician is bound to prevent with all his might, says Avicenna, for among the best efforts we can exert in the healing of wounds is the prevention of abscesses.

But before I talk about abscesses let me speak about bad complexion, hot and cold, dry and humid, material and immaterial (that is, with pus and without pus) which can afflict the head.

I say that bad complexions of all kinds occur in breakage of the head although rarely cold, material, and immaterial, and in the same way all kinds of abscesses of the brain and of the membranes can also occur, more rarely however cold than hot abscesses. The reason is twofold. First, the humors are hot and thin and mobile at first. But the cold humors, in contrast, because an abscess must occur in a solid member whose porosities are too narrow and thick for pus are not adapted for becoming solidified. Therefore, hot abscesses are more frequently formed than cold ones as also happens in the case of pleurisy, which rarely results from cold pus. Nevertheless, some times cold abscesses are formed in the head and especially in a complexion adapted for this result although they are not truly cold. But a mixture of the two is rare in a single abscess, as Avicenna says in *Canon* III, chapter 4, on abscesses in general.

Nevertheless, it often happens that a head receives a bad complexion, hot or cold, dry or humid, with or without pus and without an abscess in cases of percussion of the head and cold, as often happens from cold air entering it. This is partly due to the region where the patient lives and partly to negligent care by those attending him. Sometimes in part this is due to the weakness of the patients because they do not have warm, enclosed living quarters such as the season of the year requires. Thus a bad complexion is regarded as the reason for the abscess and is as it were the efficient cause of the abscess. If one asks what therefore is the bad complexion which is in the abscess when an abscess does not occur without a similar illness the answer is given that it is another bad complexion that has been introduced because at first in the abscess the humors run. These break the continuity and pus is retained there although it may also be laudable pus insofar as in quantity and quality it acquires ebullition because it is outside the veins and the secretion is not disposed of, thus causing bad complexion or perhaps because the pus is of such a nature that by itself without ebullition it induces a bad complexion as well as with ebullition. More will be said about this below. Thus one bad complexion will be as it were a cause and another will be the illness which integrates the abscess.

The signs therefore of a bad hot complexion without pus are derived from a primitive cause for the most part because often a hot quality from the air which has become accidentally hot beyond what is proper or, because the season and the region are very hot or the head is kept covered with warm cloths or from some very hot medicine applied locally as some unskilled operators do at the present time with water of life (*aqua vitae*) composed of various hot herbs infused and distilled, or with poultices and hot unguents unduly applied, or from anger or some emotions or from bodily movement, or because medicines hotter than they should be are administered. This happens in a complexion easily warmed and more or less slowly or quickly according to a combination of causes.

In addition to these causes heat also appears to be felt in the face and the entire head. There also occur as well wakefulness, thirst, immobility of the eyes, and activity of all animal operations unless something impedes them, says Avicenna, *Canon* III, first tractate, chapter 19, p. 170v. Bad complexion, indicated by inflammation, loss of health, wakefulness, restlessness, change in mental images, agitation, swiftness to anger, and redness of eyes, benefits from means of cooling and harm from the means of warming the body.

Signs of a frigid quality are opposed to a bad complexion and completely contrary unless loss of health is present, as Avicenna says, above, chapter 2. Cold is felt with loss of health, lethargy, loss of heat, pallor of face and eyes, diminution of mental images, a decline toward fear, and aid from means of warming and harm from those which cause chill. Signs of a dry complexion without pus are inconstant and premature evacuations, drying out of the nostrils, and much insomnia. Signs of a bad humid complexion without pus are a bit of catarrh or cold in the head, lethargy, languidity of sensation, and the evacuation is small. Forgetfulness and much sleep are also concomitants of this type of complexion. If indeed these signs are mixed they are mixed according to the aforesaid qualities and he who is of good judgment will judge them. Therefore I thought I should pass over them in silence.

Reader, I wish you to know that everything cannot be written down not because it would weary readers nor that I write for ignorant people but for those who have seen the books of other authors and who possess a natural talent for this subject. Damasscenus says that a natural talent assists art and nature, our ruler. Let readers be content therefore with these signs and pass on to other authors, but let them thank me nevertheless for my work according to its merits.

The signs of bad complexion of the membranes and of the brain of all kinds with pus are almost the same as with the signs of abscesses, according to Avicenna, as he says above in chapters 24 and 25, on the signs of the predominance of hot pus (*Canon* III, p. 170v). The signs of a choleric condition is a non-superfluous heaviness, a biting sensation, inflammation, vehement burning and dryness, stricture or contraction of the nostrils, thirst, wakefulness, a yellowish color of the face, and reddish eyes. Signs of a sanguine condition are an increase in heaviness and perhaps a pulsation and puffing-out of the face and eyes, swelling of the veins, and deep sleep. Signs of frigid pus is a sensation of cold, the length of the lesion and its persistence, little redness of face, the eyes are dull and languid, the face is white and the eyes have a little yellowish color with a heaviness which is clearly felt. Signs of a phlegmatic condition are a greater slowness of movement, coma, forgetfulness, and a leaden color of face and eyes. In the melancholic condition the heaviness is less, there is more wakefulness, alienation of mind, confused thought, and a leaden color of eyes and face. Thus also if the puses are mixed the signs are mixed and the dominant signs also point toward a dominant pus, as will be set forth on abscesses below.

Chapter VIII

Signs of Inner Abscesses of the Head

The signs of abscesses beginning with hot abscesses are as follows: continuous fever whose heat is not very strong when the patient is touched with the hand, according to Haly, *Theorica* IX, 3, but tranquil and moderate; the face and head hotter to the touch than the rest of the body; alienation of the mind; wakefulness, and sometimes a sleep befalls the patient from which he is awakened with shouting and jumping; the tongue grows black and is rough. From their clothing patients strip away something on account of the disturbance of their mind. Sometimes their eyes are tearful with neuralgic pain, sometimes they are dry, but the aforesaid signs are as above together with severe fever if some phlegm is mixed with both blood or bile. Anyone with a bloody abscess has the aforesaid symptoms, together with laughter, deep sleep, pain in the eyes, talkativeness, and foolish behavior. The fever is more intense; the face has a red color. A choleric abscess is indicated by a yellow face and is accompanied by madness, jumping about, and a high temperature which is perceptible to the touch. But if there is any black bile mixed with the abscess there are the concomitant symptoms of foolish behavior, garrulity, fear, and weeping. If a notable admixture of phlegm exists a non-continuous stupefaction appears. In all these cases the pulse is weak and hard to ascertain. There is also a variety of breathing, sometimes a shortage of breath and an ineffectual attempt to vomit. The membranes are swollen to the touch and issue forth through the fissure of the cranium colored with pus and are rendered stiff.

Cold abscesses occurring in the head are subject to domination by phlegm as hot abscesses are dominated by blood and bile and lethargy (so named from the symptom which follows it) whose signs are a moderate weak fever and a stupefaction not acute and deep sleep. The patient does not respond except barely and infrequently if interrogated. Patients are afflicted with much yawning and confusion of mind. Their mouths are open as if they had forgotten to close them. Some suffer a phlegmatic disturbance of the stomach and occasional constipation. Their urine is turbid like that of donkeys. Trembling of the extremities, sweating, a livid swollen face, a rapid, fluctuating pulse such as characterizes pneumonia, slow and uneven breathing are also symptoms. Haly says likewise that in addition stupefaction itself occurs to the brain from a bad frigid and humid complexion or from phlegmatic pus caused by an acute fever or percussion which is made against the temples by the patient's arms or an oppression occurring in the brain or from a fracture of the bones of the head or of the placed under the bone when the physician prefers this form of cure.

Excessive wakefulness is due to a bad dry complexion which occurs in the brain or from a melancholic or choleric condition with pus. By deprivation of feeling or numbness (*obstupefactio*) this author understands that lethargy dominates the patient. By pervigilation (excessive wakefulness) he understands frenzy (or continuous dementia). And so he says that sometimes warm humors are mixed with cold and humid with dry; thus the signs are composite. He says that when the causes which bring about excessive wakefulness are mixed with those which cause numbness an ill results which is called coma or wakeful stupefaction. If the phlegm exists in greater quantity the wakefulness is greater. This is a sign of a composite abscess in which the patient neither sleeps nor is wakeful, his eyes are open, his mind confused and his condition is one of combined lethargy and frenzy. Avicenna follows Haly in making this distinction of abscesses (*Canon* III, fen 1, tractate 4, chap. 4, p. 174r). He says an abscess from which headache comes is sometimes in the lining of the brain and sometimes it is warm and called *sirsen;* sometimes it is cold and is called lethargy, that is, forgetfulness. Sometimes it is composite and is called the disposition of a person who suffers from wakeful sleep. Sometimes it is hard and sometimes it occurs in the brain itself.

The prince (Avicenna) proves against Serapio in many passages and especially in *Canon* III, etc., p. 180, that the brain can suffer abscesses and that *carabitus, sirsen,* and frenzy are the same although according to some frenzy is the most important as a symptom than as an illness. But if *carabitus* and *sirsen* create an abscess of the membrane of the brain or of its substance or of both or of another member see Avicenna, as above, because I do not intend to dwell on these points.

The signs of *carabitus* are a severe alienation and sometimes a deprivation of speech and sluggishness, confusion of the understanding, and very much of these symptoms around the fourth day. On the fifth day cold and agitation occur in the extremities and inordinate agitation of breath as well as an extension of the breast bones upward, tremor and jumping of the members along with it which announce themselves before they occur. Sleep is fitful. Sometimes the patients are awakened from it and shout. Sometimes they are wakeful and sometimes they dream fantastically. Their sleep is broken, their voices are different, and their talk is immodest, bold, and angry. They abhor the rays of the sun, their tongues are confused and agitated. Sometimes they have abscesses. Very often they are deprived of speech. They ask for water and drink little of it. Their extremities are chilled without any outward apparent source of cooling. Their urine is thin, the pulse weak on account of the abscess in the nervous member. When they are quiet they do not evacuate any liquid since the brain is a humid substance. Sometimes they suffer intense, frequent trembling and spasm of various kinds. Forgetfulness of a nearby or recent thing or experience and sadness without cause precede the onset of *carabitus,* with bad dreams, severe headache, heaviness or oppression, repletion, and dryness of the eyes. Then it happens that tears flow from one eye only and the veins of the eyes are red; sometimes they acquire villous membranes like fine down and collect them while the eyes are closed. Distillation of urine occurs with or without volition and pains are forgotten if any exist in their members. In fact, if the painful members are touched they do not feel it.

If the abscess lies in the anterior part of the head it corrupts the imagination and then the patients begin to collect *villi* (downy membranes or coats) and chaff and such like. They also picture to themselves things which do not exist; in other words, they suffer hallucinations. If the abscess is in the middle part of the head it corrupts the power of thought. If it lies in the posterior part of the head the patients are so forgetful that when they ask for something and it is presented to them they do not remember that they asked for it. But if the abscess lies above all the parts of the head all these signs appear. If the brain has an abscess the face and eyes grow red and the eyes protrude markedly if the pus is bloody; if choleric, it is yellowish. Thus the colors red and yellow appear according to the dominant humor. If the abscess is due to burning bile it is fatal. The signs are a combination of symptoms which occur with demonic demonstrations of hatred and quarrelling. The vision becomes confused.

Note, reader, one thing that physicians commonly assume that cold coming to the large membrane or from the air or something cold applied during treatment causes a warm abscess although it can cause other symptoms. This is what Rhazes understood on the authority of Paul of Aegina (*Continens*, XV, chap. 3, at the end) in these words: "A hot abscess occurs in the large membrane from the pricking or stinging of the bone and the weight of the bandages or a painful ligature or from the affliction of the cold or because the patient's regimen is not reduced or from drinking wine." Many others make this judgment and especially Avicenna. The cause can be evident to the observer.

When I discussed *carabitus* above according to Avicenna's view of it I set down the signs of hot abscesses in the membranes and in the brain (*Canon* III, p. 180). I shall now discuss the signs of a cold abscess according to his view as well. Perhaps someone will wonder why I spend so much time in setting down the signs of such abscesses. I do this because of their great usefulness for when an illness is well known it is more easily cured. I set down only the signs given by Haly and Avicenna, avoiding the authority of others, because whatever is well said by these fathers of medicine is said with marvellous order and diligence. In answer to anyone who may read my book these men surpass all others on the subject of signs and causes; thus he may see that these signs are not listed only by myself. Let him read the aforesaid sources where he will find a full account of *carabitus* (hot abscess in the brain's lining), *phlegmon* (inflammation of the areolar texture), and erysipelas of the brain, and what is known as *sibare* (phrenitis) or *daemonium* of the brain, as well as lethargy, *subeth asahari,* an abscess composed of both hot and cold humors, called *cuma* (coma) by Haly, above. I do not go into detail concerning these ills.

The signs therefore of a cold abscess in the head, although it rarely occurs but is nonetheless possible, arise either from an antecedent or primitive cause; the latter is more rare. The first signs are a mild headache and a slow fever, for it is necessary that a fever occur from putrefied humor in the brain, says Avicenna and because of this it is separate from *subeth* (coma). Note, reader, that although in a phlegmatic abscess or one otherwise cold there is no true putridity. Nevertheless, in this passage Avicenna seems to mean that cold phlegmatic abscesses which he mentions there as he testifies in *Canon* III, p. 182v, on the signs of lethargy, are accompanied by slow fever and that it is necessarily present in every abscess resulting from putrefied humor in a principal member. The fever is of course slow because its pus is phlegmatic. Or he means that in every abscess there is some putridity which causes fever especially if the abscess occurs in a principal member. This is what good Dino understood in *Canon* IV, tractate 3, chap. 1, for he says that in every abscess even when it is cold there is also some heat beyond the natural heat for the sake of the conculcation or consolidation of the pus. On this see Avicenna. As to the fact every abscess is either hot or not hot let reference be made to Dino not only in the passage above but at the beginning of *Canon* IV, fen 3, where Avicenna distinguishes what an abscess is and how it is created and what is created first, whether a swelling or a break in continuity or bad complexion, where he says that on account of the consolidation of the abscess it is finally created by a bad humor which in the judgment of anyone who thinks it over will be hot because of the stoppage made therein, however much cold pus there is in it.

I believe although there is some bad complexion in the aforesaid manner in the abscess that a cold bad complexion will result also from the coldness of the humor and thus there will be two bad complexions in a cold abscess but because the cold is thus greater it is the more to be removed in the cure. Nevertheless, the cure of an abscess insofar as it is an abscess is not to remove the bad complexion especially in the cold pus as well as the hot, for instance in erysipelas, but the cure lies in removing the cold because its pus is thick. This results in the resolution of the pure and mixed pus according to the time of the abscess. Thus, however small may be the heat in such a member, a fever of the same degree of heat is necessarily present in the brain. This is the view of Avicenna according to some people in the aforementioned passage concerning *carabitus* when he says that fever is a necessary concomitant. In this opinion some adhere to the testimony of Hippocrates when he says that if blood flows into the stomach it necessarily putrefies and is converted into bloody pus. They interpret him to say that he means not only blood but any other humor not regulated by nature which immediately begins to have some measure of putridity when it is outside the veins. This is true especially when the blood is contained without evacuation and because therein it is not in the order of nature as in an abscess for phlegm in the stomach also would have a measure of putridity as well as when it is contained in the intestines and joints, deprived of evacuation or outlet.

And if indeed there were such a putridity in these members as was mentioned before there is not so much as would be able to cause a fever since in order to bring about a fever a notable putridity is required either in a place near the heart or in a place in which it would be easy to bring the heart into a heated condition. Otherwise fever does not occur nor is continuous or of any other kind. Thus I believe that in nodes [hard incrustations which form around joints] and in cases of scrofula there is some putridity acquired in the aforesaid manner.

It is not unusual to find that in one abscess there may be two bad complexions, for instance, in a cold abscess because in the same manner in which vinegar is said to be hot and cold humors in abscesses can be called hot and cold. This is in truth the intent of Dino's comment in the aforesaid passage.

It is true that in a very hard abscess converted into a stony consistency there will be far less putridity. But such abscesses do not occur in the membranes or the brain although Avicenna, *Canon* III, fen 1, tractate 2, chapter 4, says that an abscess in the head is sometimes hard because he did not deny the possibility and perhaps because there might be some fever in it. But in his chapter on lethargy he says that very much of the fever occurs in the passages or anfractuosities of the brain except when it occurs in the linings of the brain on account of the reasons adduced above and because it rarely occurs in the substance of the brain since that is viscous and dense and a phlegmatic humor cannot penetrate a dense body. Nevertheless, he says it may occur in the linings and in the substance of the brain. I believe that such cold abscesses are not created except through a gradual congestion because they cannot be caused by a downward flow. If, however, they are created this will occur through bile mixed with the abscess which thins out the phlegm and causes it to penetrate. Otherwise this abscess cannot occur by means of a downward flow of humor. I believe, however, that if the abscess occurs also in the brain either by a flux or congestion it can be such as to occur without a fever accompanied by a considerable quantity and quality of pus. The place and time of the abscess as well as the manner of its termination must be considered.

I have said these words for the sake of young men.

This fever in the aforesaid abscess sometimes is not felt and heavy coma occurs with the abscess. There is a heaviness in opening and closing the eyes, forgetfulness, a shallow, slow, weak breathing and much yawning as well as hiccups on account of the common connection of the stomach with the brain. A white tongue, slow speech, slow movement of the eyelids, confusion of reason, humid defecation, urine like that of donkeys, tremor, sweating of the extremities, a heavy, infrequent, slow, tremulous, and fluctating pulse as occurs in pneumonia are symptoms. The pulse beats are nevertheless less in an abscess of the brain than in pneumonia since damage of the heart is less in an abscess and falls into the middle range.

If the abscess is melancholic the pain is more intense and accompanied by quarrelling, alienation of mind, open, staring eyes fixed on one spot. Along with lethargy in the substance of the brain coma is more profound, there is a greater difficulty of movement, and the eyes tend to close. If the abscess is in the linings the pain is more intense, movement is easier, and there is retention of urine because of the forgetfulness and weakness of the urinary muscle.

If the abscess is mixed both warm and cold the symptoms are comprised of frenzy and lethargy, as we said above on the authority of Haly. All these signs set down above by Avicenna are the signs posited by Haly, whom Avicenna has followed. Few things are said by Avicenna which were not said before him by Haly, who was first to set down the system of medicine. May his soul be blessed for so much talent and labor.

The signs set forth above concerning abscesses are not only for one created by percussion and lesion of the head but for an abscess created in whatever way, by community or essence or primitive cause or by whatever other cause. I place an end to the discussion of signs of abscesses.

But other abscesses occur in the head, that is, sometimes on the outside of the cranium and in the skin itself which covers the head. This scalp is for the most part of little sensitivity because there are no nerves in the exterior part of the head nor muscles except those in the temples which move the jaws and those in front which move the eyebrows. Sometimes the pericranium also becomes abscessed.

Let me say something about these abscesses so that nothing may be left untouched concerning abscesses of the head. It is a common opinion that a hot, cold, and mixed abscess can occur in the pericranium just as in other members. The exterior membrane is not as great in importance as the membranes on the interior nor are the causes of its abscesses considered so carefully as far as the symptoms which accompany it are concerned nor in relation to its cure. Galen says in *De Ingenio Sanitatis* IV, 7, that stronger measures are indicated for internal than for external wounds lest the medicine whereby we must comfort them fails before it reaches them.

As is clear from Avicenna, *Canon* III, fen 1, tractate 3, chapter 11, p. 183r, in these words; "The cure of the ill is with gentler medicines." In the cure of *sirsen* so that you may be secure in the administration of stronger medicine you should consult the words of the faithful expositor, Jacobus De Partibus (Jacques Despars) in which he says that it is better to apply lighter remedies to the external rather than to the internal part because the power of medicine works more easily on the outside since the inner part is more distant from the medicine and because the cranium is hard, solid, and thick and lies between it, power cannot penetrate unless it is strong. Therefore a weak power is more suitable to the outer than to the inner part. The action of the medicine is also greater and the danger in the power of a strong medicine is greater than that in a weak medicine. Therefore an external abscess is not of such great importance.

Jacobus adduces above another reason when he says the outer part sustains stronger medicines because there is less danger in administering to the outer than to the inner part since a strong medicine can possibly do harm. If it is placed on the abscess it is better, that is, less harmful to do so on the outside rather than the inside. Consequently let me say that there is less harm in an external than in an internal abscess not only for the reasons given but by reason of the nobility of the member and its location.

Therefore I shall close the discussion of abscesses of the outer membrane because they are very rare and occur, I believe, due to a powerful cause which will as in many cases give rise to an abscess in other membranes through their strong connections. A greater light throws shadow on a lesser one. Thus the physician will not spend his time on symptoms of abscesses of the pericranium nor its cure but will devote himself to the cure of a greater ill.

If such an abscess does occur it is possible that symptoms will be readily held to be the cause if it is created from a primitive cause and thus a cure is possible. But if the abscess is created by a cause not primitive you may take care of it according to the symptoms and thus cure it: see our prince Avicenna above.

But because abscesses are not only created in the pericranium but sometimes also water and flatulence collect in heads and especially in those of children you will have a complete recognition there of the essence, causes, symptoms, and the cure. Let these words suffice concerning abscesses of the membranes and of the brain. I beg forgiveness for my long-windedness especially concerning symptoms.

Signs of Pus on the Membranes

The signs of pus which has flowed down upon the membranes or has been generated therein are the following: there is an intense fever, tremor, destruction of the reason and other symptoms described in the lesion of the membranes and of the brain, as Avicenna says concerning cranial fracture at the beginning in these words: "There occur before the advent of saniosity or ichor (bloody pus) or after it bad illnesses from fevers, tremor, destruction of the reason and others." (*Canon* III, fen 5, tractate 3, chap. 1, p. 460v). In another passage he says: "Other ills occur with abscesses of the head since before the saniosity there arise the aforesaid symptoms in abscess of the membranes and brain. Even though the abscess in the head does not result in bloody pus, there occur fevers, tremors, and the aforesaid symptoms and from the bloody pus contained under the cranium there arise paralysis, spasm, apoplexy, and other illnesses mentioned by me."

When the necessity is established for extending, that is, rubbing the bone and extracting it then haste must be exerted and one must not wait for the completion of the generation of pus in the fracture or under the bone since pus is the cause of bad concomitants.

It is true that apoplexy does not occur except through coarctatory stoppage or stricture by the pus flowing down to the venters of the brain. This can occur if the membranes are broken or because in another way there is bloody pus in the brain, for example, if there is a ruptured vein in the *pia mater* which causes bloody pus, which in turn causes apoplexy.

Thus also this pus will cause different concomitants according to the locations to which it may be transmitted and according to the quantity and quality of the pus, creating larger and smaller accompanying symptoms or concomitants and according to its free exit since even a small quantity which remains without being removed will cause grave consequences.

I saw at Bologna in the case of the revered master Piramo dei Pepoli, the following situation. He had a capillary fissure in the cranium through which some pus had descended. Treatment was administered with instruments to discover whether the little crack penetrated to the inner surface of the cranium. This was found to be true by those operating on the gentleman. Through the dilatated fissure there issued a moderate amount of bloody pus, almost none at all. His very acute fever ceased immediately together with his periods of restlessness and wakefulness as well as all bad symptoms which were present. I saw the same situation in very many other cases.

Chapter IX

Doubt as to Whether the Symptoms Arise from the Abscess or from the Break in Continuity of the Cranium or from Bloody Pus since the Symptoms are Common to These Various Conditions

But there is doubt in judging whether such symptoms arise from a break in the continuity in the membranes and in the brain or by reason of an abscess or the bloody pus contained under the cranium when the aforesaid symptoms are common in all the aforesaid conditions.

In order to remove such doubts let the physician be prudent and diligent in his diagnosis because such symptoms occur suddenly through lesion of the membranes and the brain. We say that they arise necessarily from that cause even if they come a little later after the injury has occurred.

Beyond this the physician of superior dependability sees a noticeable fracture or incision or perforation and if he does not see it at least he will have considered the cause of the injury. If this is serious he will judge those concomitants to follow from the break in continuity. What is certain is that if such symptoms come suddenly or a short time after the injury occurs and there is no collection of bloody pus at its location nor an abscess at its location the injury is caused by a break of continuity. In addition to this the aforesaid symptoms which occur are strong, sudden in their state, and thus it does not happen due to the concomitants of the abscess nor of the bloody pus contained because in abscesses such symptoms have an increase at the beginning and have longer periods of time, that is, in the abscesses and in the bloody pus contained under the cranium.

But because the symptoms of bloody pus and of abscesses, especially warm ones, as I said above, are similar and also agree in this fact, that they do not occur except a considerable time after the injury there will also exist doubt whether they are due to the abscess or to the bloody pus. In regard to the doubt I note the distinction of the symptoms aforesaid and I say that the symptoms of the abscess are greater than those exhibited by the bloody pus within the cranium because the abscess is of greater harm to the brain and the membranes than the bloody pus, as is clear to any intelligent observer. In addition to this I say the physician recognizes it to be bloody pus because some thin pus resudes from the fissure of the cranium, if there is one. The cranium will also be of bad color, as I shall explain more fully when I discuss the signs of the separation of the membrane from the bone, especially if the bloody pus is abundant and of bad condition and especially if the fissure is narrow or perhaps does not exist.

Sometimes there is also much bloody pus upon the membranes, laudable pus however. It does not create bad symptoms as happens in wounds and fractures in which a large part of the bone is moved aside and the membrane is laid bare from which the bloody pus freely issues and is well cleaned and purged, but the bloody pus which creates the aforesaid symptoms is of bad odor. The pus of the lips of the wound is of a bad kind and greater insofar as it is in the abscess because in the abscess the lips are dry and of bad color and the head is warmer in the abscess than in the pus.

If the pus were within the cranium when the latter is not fractured, by means of some little vein ruptured in the membranes the cranium becomes badly colored and the sick person feels a heaviness in the area in which the pus exists. Sometimes the pus comes out through the palate, the nostrils, and the ears.

In addition to other symptoms the physician must consider the causes of the abscess and the causes of the pus, whether the body is plethoric (full of blood) and how regulated and what medicines are being used.

Among all these considerations if the physician has doubts about the pus he should open the narrow fissure or if there is no fissure he should perforate the cranium and verify the presence of pus since in almost every illness there are doubtful symptoms. With diligence, shrewdness, and caution and without delay the physicians ought to perform these functions.

Nonetheless, I say that in distinguishing these symptoms there is great difficulty and they are not recognized except by one who is greatly skilled and who by some conjecture may recognize them because these symptoms cannot be completely described. Only a good man with talent who carefully reflects, reviews his findings, and puts the facts together on which a reasonable diagnosis can be based and who has spent a long time handling similar cases can understand and judge since there is much in medicine which cannot be written down, as we see continuously.

Chapter X

Signs of a Bone Pressing upon or Piercing the Membranes and the Brain

There follow the signs of pressure or a piercing of a bone upon the brain and the membranes which are gathered from many sources and first from the object which produces the injury, which might be an arrow or a dagger or something which can perforate as in many cases when some small piece of bone descends below the cranium and is either separated or not from it.

These cases resemble the result when some iron or brass plates or sheets are perforated many times or with just one hole which causes the inner surface of the plate to be pierced and made rough so that it punctures whatever it comes up against or grates against it like the common instrument used for grating cheese and bread which is in daily use. This instrument is called scabula from *scabo, scabis,* by recent writers in Latin. It comes from the Greek Τυρόχνηστις that is, tyrocnistis, or cheese grater, which in the Bolognese dialect is called *gratusa.*

In addition to the consideration of this cause the patient feels a continuous piercing pain in the place which has been injured and immediately upon being injured. The cause may have been a blow that broke the cranium and bent it inward, as a good physician can judge, which presses upon the cranium and punctures the membranes. This can be ascertained with the help of the patient if he is able to talk, but if he cannot he can touch the place affected frequently with his hand.

Sometimes due to such pressure upon the membranes and the brain apoplexy results. The authority for this is Rhazes, cited by Niccolò da Firenze. He says: "Some one told me he had seen a patient whose large membrane was injured. Pressure caused by this condition resulted in apoplexy. When the pressure was relieved he returned to his natural condition." He adds that the season was summer; if it had been winter he would immediately have been chilled, and this would have brought on an apoplexy for which there is no cure.

Note, reader, that apoplexy results from chilling. This comes about, I believe, through pressure or perhaps mortification and extinction of the animal spirits. Thus death results. There is also pressure not only from the bone but pressure from some other source which can cause apoplexy, says Rabi Moyses, *Aphorisms,* XXV, chapter 60, on Galen's authority. He also said (Galen 7.144; 17 B. 626) that once the fractured bones of the head are extracted it is necessary to replace their support of the membrane of the brain by the use of an instrument called the salvatorium. If with this instrument he had exerted a little more sustained pressure on the brain the patient would have lost sensation and all voluntary movement. To lose these is nothing but apoplexy. You now see how careful the operator must be in such a task. But sometimes it happens also that from a contusion that exerts pressure in this way apoplexy does not result nor such serious consequences.

They say, however, that some people whose bone has been bent inward without rupture of the skin and the cranium have bad dreams, that is, they dream that the enemy is attacking. They leap up from the bed and shout while they are asleep and flee and take up weapons as if they were awake. They do this because their imaginations are injured by pressure from the cranium. Niccolò says this happens if the patient is a boy and if the pressure is great because the *dura mater* has suffered abscess and possibly the brain as well and bad symptoms follow. However, I have seen a great and notable pressure or in an incision from a heavy object which falls not lightly upon the head and descends considerably into its surface requiring an elevation which is then carried out. The bone will remain in place as before.

The reason for this is that the bone can be nourished since it is not entirely separated although it is depressed in one or two places but elsewhere adheres to a healthy, sound cranium from which the injured bone draws nourishment and because it is not separated from the *dura mater* and the pericranium. The *dura mater* is always healthy. As long as the head is not fractured or abscessed it is attached to the cranium at all points, as I shall explain in more detail, and thus the cranium is nourished and consolidated by it.

As to the fact that the cranium is nourished by the *dura mater,* I saw in my practice at Florence a boy of twelve or thereabouts, the son of a dyer, who had been kicked by a mule. His cranium was fractured over a large area of bone and depressed inward about the width of a knife blade and separated throughout. Together with master Alessandro da Ripa (or Riva), a natural philosopher, and a certain man named Tansura, a surgeon, I was called in for consultation. When we saw the depressed bone we decided to lift it up completely with the appropriate instruments. But in the process we saw a notable vein had been ruptured from which a considerable amount of blood was flowing and we recognized the great danger involved. We released the bone into its place again because it was holding back the blood, thinking we could remove it when the time was right. As we did so we saw the bone was in a healthy condition, nor were there any bad symptoms.

I proceeded alone with the cure of the patient, and I saw the bone was consolidated from the sides by means of a callus. I released the bone to its position and the patient was perfectly cured. I had seen other patients before and after this one whose cases I refrain from describing for the sake of brevity. Their cases were similar to this one. I have also seen many depressed bones in the head of children which had been caused by falls and also in infants due to the carelessness of those who delivered them at birth. The children I saw I cured with my wax unguent for use on the head. May its inventor's soul [i.e., his father's] rest in peace because there is nothing like it in the world for wounds of the head and fractures which I shall describe when I take up the cure of head wounds. These children did not have the dreams I mentioned earlier. I think this was because the depression of the bone was not sufficient to cause them.

It also happens that the bone punctures and oppresses the membrane in a notable fracture of the cranium not only due to the object which strikes it but also from a cutting instrument, for weapons do not always make the lightest of wounds and because the bones are for the most part breakable and like glass. When a sizable fissure or cut is made in the cranium which penetrates inward some pieces of bone fall into the depths upon the membrane, the more noticeable according to their size. When the fracture is larger in the second table, that is, the lower one, or to speak more clearly, the bones on the inner surface of the cranium are larger they puncture and oppress the membrane. In such cases the physician must saw the cranium laterally and broaden the fissure to extract the bone because otherwise no cure can result.

I had an outstanding case of this kind in a certain Filippo Donella, of Carpi, who had remained a year with a large piece of bone under the bone of his skull. His wound was quite extensive and entirely consolidated except that its edges never could be consolidated and perfectly closed. It had two little orifices or fistulae from which oozed bloody pus for at least six months. This man was cured by his brother, who was a pretty good operator, and by my father. I came on to the case later, opened up the entire wound down its length and spread it out to the sides. I found a long thick fragment of bone upon the membrane and extracted it. Then I cleaned the membrane and thoroughly healed the patient. He is alive today in good condition.

Note also that often under the bone of the cranium there are sizable pieces of bone which do not puncture or oppress the membranes, giving rise to no serious symptoms. But if the physician is an expert he will recognize by some indication if there are bones under the cranium especially when he sees the cure of the patient is being prolonged beyond what is necessary. When he sees bloody pus issuing from under the bone without serious symptoms of another sort then he will judge the pus from the little piece of bone is hindering the cure, because if there were pus from some other cause the symptoms would be serious. I have often extracted bones in similar cases from head wounds. If the foramen is open nature herself expels such bones, slowly it is true, but it is better if assistance is provided by the art of medicine.

In another manner also pieces of bone descend under the cranium. Sometimes physicians when trepanning the skull use instruments not adapted for the purpose. They break the cranium and bits of bone enter between the membrane and the cranium. Thus they puncture it or not, as the case may be, as I said above. They are burdensome according to the amount of bone involved or the manner in which they impinge upon the membrane for sometimes they touch the membrane parallel to its flat surface and thus do not puncture it, or they touch the membrane with some sharp point and thus puncture or oppress it if the bones are large. Nevertheless, by thus trepanning the bits of bone cannot be very oppressive because they are small and light in weight.

I was present and saw this operation of trepanning, noble prince, in your head in whose case I took my part. In the absence of instruments made for the purpose the trepanation was such as could be performed under the circumstances and finally some portion of the bone entered under the cranial bone. With the assistance of the grace of God and medical skill the bone was drawn out and you were restored to health.

The absence of the instruments was due to my ignorance of the true nature of the illness involved since I had been called in as a consultant. Similarly, some other physicians had been summoned with equal haste from a distance of one hundred fifty miles without being told the nature of the illness from which you were suffering and thus there were not at hand the instruments suitable for such an operation. Hence arose the error in trepanation. However, by the aid of our divine leader, the Lord, you escaped with your health.

From what I have said it is clear how serious the problem is in weight and importance when the bone pierces and oppresses the cranium because either by itself or from elsewhere it can bring on the most violent consequences and death.

Chapter XI

Opinions Concerning the Adherence of the *Dura Mater* to the Cranium

Now let us talk about the signs of the separation of the *dura mater* from the cranium. Before we do so I say that I cannot help but wonder that there are not a few authors who hold that the *dura mater* is always separate from the cranium except at the places where sutures occur. In this point they all agree that there is attachment. These authors are in complete error; one might even say they are complete liars.

The truth is apparent from the authority of Galen, whom Rhazes quotes in *Continens* XV, chapter 3, around the middle of the chapter in these words: "Either part of the fracture will come through completely under it and possibly will be removed from the intact membrane or possibly not, etc." In these words he considers that the cranium is attached to the hard membrane. In *On the Assistance of the Members* [*De Usu Partium* III K.], chapter 5, Galen considers that this attachment is necessary, for he says that it is impossible for a thick covering not to be applied to the skull on account of the distance of the membranes from each other. In order that they may be applied to the cranium there arose ligaments for the purpose; these are thin coverings which arise from a thick covering. Where these issue from the skull there the skull is porous and when they issue forth each of them is expanded over the place of exit and all of them are clearly spread over the skull, meeting and joining with each other until a single covering is formed from all of them which obviously covers the entire skull. Thus a thick covering is bound to the skull.

Haly says the same thing as does Avicenna in his chapter on skull fracture, although there is perhaps some difference in their views. Among other authors Paul of Aegina holds the same opinion as cited by Rhazes in the aforementioned reference on the authority of Galen. Many others on the basis of their experience agree on this point, for I have often demonstrated the fact in a public anatomy.

Any one can discover this if a skull is carried around for inspection at an anatomy open to visitors. Let him cut the entire membrane and cranium gently so that part of the head is separated from the rest without exerting extreme force and there will appear to view the *dura mater* attached to the pericranium equally throughout.

I have often tried to see whether the *dura mater* adheres more strongly at the sutures than elsewhere, and, by my professional honor, I swear that it does not. Let others say whatever they wish: I believe that throughout the aforementioned ligaments issue from porosities of the bone, as Galen says, and are attached to the pericranium or create the membrane itself and thus each of them is found to be attached equally to the cranium.

Nevertheless, I say I have often dissected the cadavers of foetuses of four or five months of age in which the sutures of the skulls had not yet closed as they do in older people, but the *dura mater* and the pericranium were joined with a strong bond throughout where there was no bone as yet. Thus nature increases and hardens the bones of the head day by day within the membranes either from prime matter of sperm from the parents or from some other nourishment transmitted from elsewhere, concocted and assimilated by the skull. Therefore in the location of the sutures the membranes appear to be necessarily more attached and united because at the place of the sutures between the *dura mater* and the pericranium there is no substance of the brain which intervenes.

But indeed I believe that from the beginning before it is recognized that the cranium lies within the membranes it is covered equally throughout by the aforesaid ligaments. These remain more connected and close to the entire head at the site of the sutures. According to some authors through these places more nerves and ligaments issue forth than elsewhere. But as I said above I do not know how to separate sense from experience nor do I know how to think of a reason which proves it to be true; however, what creates the sutures is not part of my present purpose. In my work on anatomy *[Commentaria]* I shall discuss this subject in great detail.

I believe it is on account of the following reason many say the *dura mater* is connected by sutures to the exterior membrane and that through the sutures there issue forth nerves and veins and thus it is that the *dura mater* membrane is entirely filled with nerves and venous like the other membranes. However, I believe that it is uniformly nervous because the nerves in the membrane are not distinct, nor do I find a reason why the nerves should be larger in one part of the membrane than in another.

In the aforesaid manner nerves issue through the sutures. It is true that the veins and arteries in the membranes are larger in one part than in another because nourishment must always be ready to supply the members and blood cannot stand outside veins because it would putrefy. Therefore I say that nerves and veins issue forth through the sutures in the manner described above. Nevertheless, this is not to say that the nerves and veins contained in the *dura mater* do not pass through pores of the cranium elsewhere.

These present a danger in operating in the vicinity of the sutures. However, I declare that I have seen many wounded patients and cared for them, extracting bits of iron which escaped through the sutures, nor have I seen in them that great difference which many postulate who are great physicians with the pen and the word. I believe that they have not carefully studied anatomy. I say that the membranes are more attached at the sutures than elsewhere because a bone does not intervene there. Therefore it is good while operating to be very careful with the sutures. For which reason they were created I shall discuss elsewhere.

As to the fact that the membranes are created before the bones we have the authority of Galen, *De Temperamentis*, II, chapter 1 (Vol. I K.). He says, "Let us consider therefore that the living creature begins to be created in the womb so that we may know how it is according to the final humidity and warmth and this is so because the first constitution of the living creature is nothing else but from blood and sperm. These two are made up of nothing but warmth and humidity which then gradually and incessantly begin to dry up until from them are produced first the membranes, tunics, viscera, and vessels. Later and lastly bones, nails, and cartilages etc. are created."

Chapter XII

Signs of the Separation of the *Dura Mater* from the Cranium

Since the greatest danger in trepanation is with the *dura mater* since it adheres to the cranium throughout, as I said, and because it often happens that it is separated trepanation should not be performed where it is not separated, as I shall discuss in its place. Therefore let us list the signs of separation. They coincide somewhat with the signs of concussion of the brain and with those which indicate pus contained under the ruptured or non-ruptured cranium. Nevertheless, they are distinctly different. Because the bone is found to be separated in many fractures and in different ways I intend to set down the signs of separation of the bone from the membrane when that separation cannot be determined by visual inspection, that is, because the bone is not fractured or if it is fractured there is only a capillary crack and because the pus is shut up or contained between them. Then an operation must be performed.

But someone will wonder how it is possible that when the bone is not fractured the *dura mater* is separated from the cranium. I say and, reader, pay close attention, that sometimes by contusion some little vein contained between it and the bone is ruptured in the *dura mater* from which blood flows and putrefies therein. By necessity those small ligaments of the *dura mater* which are attached to the bone also putrefy and thus the membrane is separated and suffers serious symptoms. Death is the result unless there is succor.

Even when some vein is not ruptured by contusion those ligaments of the *dura mater* from which something resudes are ruptured and thus from the upper regions by the same pores the poison descends and unless help is provided serious symptoms occur and death, as above.

It also happens that some medicine which is unctuous and putrefactive is of assistance. I have seen this many times. But among other situations note this one. When an object has cut the head superficially it occurs that some part of the cranium is removed slightly through which the *dura mater* readily falls because its ligaments by whose mediation it is connected to the pericranium by way of pores being cut become more relaxed. Thus also the surface of the bone which is more dense than the middle part is removed and consequently the bloody pus is more apt to descend. Because of this fact death very often results in this case, first because those who know this art of medicine do not know this particular type of case and if they know it many physicians of our time in their ignorance desire surgeons to operate in their own way and are dominated by the latter. Thus the work required is trepanation and the ignorant physician does not wish to perform it or if he wishes to do so (since sometimes expert physicians are found who are in accord with the surgeons in these cases) the patient himself fears such an operation as do the relatives and bystanders. Thus the patient dies with a general benediction. I am very much afraid of such cases because it appears that the illness is a light one whereas it is really serious and difficult. Hence the very appearance of a minor ill is an impediment to the work of physicians due to the aforesaid reasons.

Let us therefore list the signs of separation. Either the bone now begins to be separated or is already separated as we approach the situation. If it is beginning to be separated perhaps this may be due to the relaxation of the ligaments or because of their rupture. Then the bone will begin to change color somewhat. This change takes place through various stages, now much, now little, according to whether the bone has remained without adhesion to the membrane since the membrane vivifies the bone by means of little veins and arteries which exist in the membrane itself by which the latter is also nourished and vivified. The bone is healthy to which the *dura mater* adheres, white mixed with red in color. The greater the separation of the one the greater is the area of the bone which is changed in color. The physician should be pleased to recognize these colors. Only he who is expert and practiced recognizes them in such cases just as experts in gems can tell genuine jewels from fakes and inferior ones. Thus the healthy color differs from the unhealthy one according to the quality of bloody pus contained under the bone itself and according to the length of time, brief or moderate, the pus has been contained therein because the vapor that rises from the pus issues forth in some manner through pores of the cranium and colors it with its color. What the colors of the pus may be is known to anyone and beyond the color the bone is also recognized because it is drier than the healthy bone at the point of separation. It is true the dryness is greater if the membrane is abscessed or if the bone is separated from the *dura mater* which has pus freely issuing from it because in some manner the vapors from the pus retained humidify the bone.

Nevertheless, in each case the membrane is drier than if it is not separated from the bone. In addition to color and dryness when the separation begins there arise some serious symptoms such as fever, alienation of mind, stupor, wakefulness, and the symptoms mentioned in the lesion of the membranes since pus begins to collect upon the membrane and corrupt it. Even greater pains occur than if the membrane is not separated and thus little by little such symptoms increase as the pus gradually collects between the bone and the membrane.

From what has been said you can gather what are the signs when the bone begins to be separated and what are the signs when it is already separated. The symptoms follow according to the quantity and quality of the pus as well as the nature of its location, because if it is near any of the nerves from the brain it induces spasm or paralysis of those members to which these nerves pass. Therefore the physician should not be ignorant of the connection of the members so that he may know how to identify the causes of the symptoms. Sometimes the pus may be localized between the *dura mater* and its sister having issued from some vein that is ruptured in the *dura mater*, near the *dura* or in the *pia mater*. Then greater symptoms occur according to the nobility or eminence of the place injured. Perhaps the bone is not separated from the membrane and perhaps it is. This case is one of those in which some patients do not escape death except by the will of God unless the hard membrane is opened or ruptured and when an opening is made in the cranium by a strong nature and by a physician's careful operation to dry out the pus.

In addition to the aforesaid symptoms a hot abscess also occurs in the membranes. Rhazes, *Continens* XV, chapter 3, on the authority of Paul of Aegina says: "I say the symptoms of a fracture must be given from the place where the thick membrane is removed and, first of all, the condition of the membrane must be ascertained, whether it adheres to the bone or not. If it adheres to the bone a hot abscess will not be created in the wound. And although a moderate one may occur and a moderate pus drips from it the putridity will be digested but if it is removed there will be more vehement pain and fever. The color of the bone will be changed and corrupted and a thin putridity will drip out. When these signs are perceived let an incision be quickly made in the fractured bone since unless this is done worse conditions will set in, such as first spasm, vomiting with bile, belching, alienation of the mind, syncope, and continual fever. If these conditions occur do not try to operate on the patient."

Avicenna sets down this opinion word for word in his chapter on the fracture of the skull, which I believe he drew from Paul as follows: "Beware of rubbing a great deal. When you are already secure and recognize the disposition of the membrane, whether it is maintaining its position or not in reference to the bone, then the danger is less and the situation is more apparent. The eventual result of the abscess is less and safer, the appearance of the ripe pus is swifter and more complete. Or percussion may already have separated the membrane from the bone. This situation is more to be feared. Pain and fevers and what follows are greater and the perception of the altered color of the bone is swifter and the course of the virulent pus is greater in it. There is a greater development of pain, fever, tetanus, syncope, and destruction of the reason on account of the remission of the cure" [cf. Cael. Aur., *Acut.* 2. 3. 13; 2. 18. 108].

Haly lists the aforesaid signs in *Practica,* IX, the chapter on skull fracture. To these in the cases mentioned I add stiffness or rigors which I have never seen without the aforesaid separation whether the fracture is manifest or hidden, and I have observed this for a long time. Let the operators therefore observe the pre-described signs so that they may know the time for opening the cranium, as I shall relate in its place.

Chapter XIII

Prognostic Signs in Lesions of the Head

Now let us pass to prognostic signs or judgments in which exists the laudable purpose of medicine, when the man in charge of the case considers what ills may take place in every instance, although he may not by any means be able to cure them all. This is the opinion of the divine Hippocrates in *Prognostics* I.

Galen demonstrates the usefulness of prognostics in his book on Hippocrates' *Prognostics* [*In Hippocratis prognosticum commentarii* III, Vol. XVIII B.K.] when he says in I, 1: "One of these uses is that when the physician uses prognostics the patients accept from him his prescription for them. Another is that when he first recognizes what has happened to the patient he anticipates what is to come by a long period of time and prepares himself for combatting it. The third is that it should not be his fault as the cause of death of any patient." He has the same opinion in *Ars Medica* I [Vol. I K.] when he says prognostication shows that the physician is not to be blamed for the death and it shows he is obediently laboring at a cure and preparing for it much before the case he is handling as an aid in time. He says in *Prognostics* I, 3 [*In Hipp.* etc.] that it is entirely possible for the physician to anticipate and to resist all eventualities which may occur as if the wise captain of a ship who fears the violence of a sea which dashes upon him.

Therefore I pray to the highest God that he direct me to an accurate prognostication because nothing is tougher, harder, scarcer, and more difficult in medicine than to deliver a correct judgment, as that great man from Cos said, laying aside everything else: "Judgment is difficult" [*Aphorisms* I, 1].

First, I say that physicians should be cautious in making a prognosis of lesion of the head because even a minor lesion can cause apprehension, first, because it occurs in the noblest member of the body and because we have seen many similar cases become dangerous.

Many times minor lesions occur to a body with bad *chyme,* that is, depravation of the humors, and it is not treated with diligence, so that either from itself or from elsewhere there follows a bad end. Sometimes a skilled physician is not called in who is competent to treat such lesions, or if they call him in they do not believe his prognosis of danger to the patient. Many people think a physician practices for the sake of honor or money and they become disobedient not only toward the use of the surgical instrument but also the diet, drink, and other regimen required, and due to this behavior the ignorant mob blames the physician although the bad end which follows absolves him from all blame. Suspicion is also present in regard to present-day operators in cases of lesion of the head because good surgeons as well as good physicians are rare. O good gods, how many physicians and what kinds of physicians there are to be found! Surely it is only in this one art it happens that just about anyone who professes to be a physician is believed to be one although there is no greater danger in any lie than in this. Many are found who dispute in a loud bawling voice and for their dying patients weave the woof of knotty points of Hippocratic doctrine to the warp of Ciceronian rhetoric, although when the patient dies they wax arrogant and glory not in the actual facts but in the empty elegance of their language. These liars, powerful not in genuine knowledge but in mere vain eloquence, should be avoided like murderers and poisoners.

These days physicians disdain to be called surgeons, that is, handworkers, but in order to extort money from their patients they claim to know the art of surgery. Yet they reveal themselves to be worthless souls in the act of operating and as participants in their search for gain they bring in fake surgeons and thus the blind lead the blind and both fall into a hole. Pardon my bluntness, but these men are not physicians because true physicians are skilled in the use of a threefold instrument, as was the situation from the time of Guy de Chauliac back to Avicenna. All physicians were surgeons and natural philosophers as well, but I believe there were many earlier physicians who would have operated if they had known how to do it. The most important reason why they did not do so was their ignorance of the method involved since no surgeon is skilled unless he has spent his life from boyhood in practicing the art.

Diodorus Siculus 2.29.4 says the Chaldaeans excel other people in science because their boys following their paternal descent devote themselves to philosophy exclusively so that from a tender age they are trained in that branch of learning. The longer they persevere in its study the more learned they become.

Concerning the art of surgery, tying off, cutting, cauterizing and other surgical operations, those manual skills, and other surgical operations are included, but since such surgeons are rare these days who are inbued with such great learning there is now a scarcity of them.

For this reason Hippocrates said: "Many call themselves surgeons but few really are surgeons." It is more important that the natural philosophers (or physicians) present on a case should be trusted more than the surgeons, who are a rough, disorderly crowd which does not know which way to turn. Let them spare me, therefore, those who are of the stock of Hippocrates, if my words apply to one or more of them, not to all. Their names from among those I have mentioned I raise to the stars.

Following the prognostic signs on the basis of what I have said every lesion of the head is to be feared; when properly operated upon there is nothing to fear. I insist that wounds and contusions which do not penetrate the cranium and also those which do penetrate without lesion, however, of the membranes and the brain are not fatal when diligent care is taken of them. When I say fatal here and elsewhere I mean fatal in the general sense.

But if the lesions are of the sort described earlier I say that they are generally fatal, not that some of them are not healed, as witness Galen on Hippocrates, *Aphorisms* VI, 18: "Incision of the bladder, heart, brain, kidneys, liver, and the slender intestines is fatal."

Galen says he saw a certain woman in the province of Samarius in a city of Nubia who had a prominent lesion in the brain and in *De Usu Partium* VIII, 10, he tells of a man who had one venter of his brain which was perforated. Both patients were cured. Jacobus de Partibus (Jacques Despars) in his chapter on head wounds, I, 3, on the authority of Avenzoar, *Theizir* XIX, 1, has these words to say: "How noble is the statement of Galen when he treats of fracture of the membrane of the brain, for it is well known among all, always and everywhere, that he whose membrane has been broken cannot live. Galen saw a certain person whose membrane had been broken and he recovered. He said this patient survived due to his great strength and wisdom. Perhaps this statement is too narrow because when Galen described the aforesaid patients he had not yet seen more cases."

I believe this is true because he expresses other views elsewhere, as has been revealed above. Let us accept nevertheless his word as retailed by Avenzoar. This is adduced as the truth in general and more so in the *pia mater* than in the *dura mater*. Avicenna, *Canon* IV, 4, 4, chap. 10, p. 430v, holds the same opinion as Galen when he says that wounds which grow worse in members usually result in death. Exceptions are rare when the members are affected. These are the bladder, brain, kidneys, liver, and the slender intestines although they can recover if the injury is slight. He says the same thing in the chapter on the disruption and extraction of arrows. He says: "If the arrow is fixed in some principal member such as the brain, heart, lungs, abdomen, intestines, liver, womb, or bladder and signs of death appear then we must abstain from drawing out the arrow since a great deal of discomfort will result from it and in order not to give rise to foolish talk when this would do little good to the patient.

"But if other bad symptoms should not appear from among those concomitants which we fear then we may allow talk about the symptoms which result usually in death, but from there on we shall begin the cure. For many times from those symptoms some one happens to be cured miraculously beyond expectation. Often a part of the liver and something of the peritoneum is extruded outside the abdomen and the entire matrix and death does not result. But if we release the arrow again back to its place in these principal members death will result according to the entire disposition of the case and we shall deserve very little mercy. But if we draw out the arrow perhaps the patient will sometimes be saved." Avicenna holds the same view, that not only does the brain suffer a breakage of its continuity but abscess also occurs in the brain and consequent suppuration but death does not result; this is implicit in his words. If one reflects on his statements he postulates the possibility of recovery, as appears in his words in *Canon* IV, fen 3, tractate 1, chapter 20, p. 416v, on warm discharges: "It is preferable that the eruption is to the stomach itself, which is a member with a passage way to the exterior of the body. When it is ruptured toward its interior and concavity it is better to be ruptured thus than toward its exterior and toward the epigastrium which contains the belly just as its eruption to the two anterior ventricles of the brain is more preferable since there are passages for both such as the nose and nostrils." Avicenna took over this entire discussion from Galen in his book on different complexions [*De Temperamentis libri III* (Vol. I K.), chapter 4] where he says: "but if there is this eruption in parts of the stomach there will be a more preferable collection or discharge in its breadth than in its exterior and toward which the discharge of pus will take place generally. A collection of pus beneath the peritoneum is bad. But when it occurs in parts of the brain then it is more favorable in the two anterior ventricles. A collection under the two membranes and in the ventricle in the posterior part of the brain is bad." This statement is repeated by Rhazes, *Continens*, chapter 4, thus: "If a discharge occurs in the recesses of the brain its collection and putrefaction will be more favorable if these are carried out toward its aforementioned concavity than toward the two I mentioned since the discharge will drip toward the nose and the palate. If the collection of pus occurs under the *pia mater* and in the posterior concavity of the brain it will be bad." But perhaps neither Galen nor Rhazes understood sufficiently the discharge in the anterior substance of the brain as Avicenna understood it to be, at least in the membranes.

As to the injury and healing of the brain the Conciliator in *Differentia* 181 holds the following to be true as do many others, and if some hold a contrary view this is because they have seen little and know less. I myself believe and assert that up to this day I have seen six men from whose heads a notable quantity of brain marrow had issued forth and they were healed. Some of these died not much later from apoplexy. Some of them, especially two, suffered permanent paralysis of one side; nevertheless, they lived for two more years. Of these, I saw three and cured them in the territory of Carpi when I was still quite young, and in spite of my youth I was not deceived. I had faithful, skilled medical men in whose company at the first or second visit to the patient I extracted from the lips of the wound a large part of the brain which had come forth by itself from the cranium. One patient I saw at Pistoia whom a certain Angelo, a Jew, a quite skilled surgeon, was treating, and he was cured. Two others I saw at Bologna, one named master Vincenzo Ragaccia (Ragazza). The other patient was master Paolo, the nephew of Cardinal Bakócs [Histrigoniensis, Strigoniensis, Tamás Bakócs, primate of Hungary, born *circa* 1442, died 1521; from Erdöd, Hungary]. In my attendance upon this man I had many very noble witnesses and learned persons. From him I extracted at my first visit some portion of the brain. Then on the thirteenth day another sizable portion emerged and he progressed finally to the sixtieth day without any bad symptoms. The hole in his brain was quite deep because his injury had been caused by the tooth of a weeding rake. This piece of metal remained in a perpendicular position in his brain for a day. It was four inches long. I extracted it with great labor by means of a grasping tool since it could scarcely be seen and taken in hand. In the same small hole I kept a tent for fifty days or thereabouts because a watery discharge kept oozing out in abundance; finally, the discharge was reduced to nothing and I took out the tent, which was a *canula*, and I tried to consolidate the wound.

Around the sixtieth day because of the pus contained in the brain a very great attack of epilepsy supervened with extreme shuddering and rigor of all the members. Seeing this, I ordered the patient's feet to be elevated and the head to be depressed. With a probe I opened the hole under the cranium little by little and I found there a large quantity of pus, watery and milky in color, which when removed put an end to the epilepsy and brought a return of sound mind to the patient. Seeing this, I inserted the *canula* once more and washed out the hole with water, using a syringe in such a way that I dried it out completely and the patient was restored to health. He lived a long time afterward and reached the heights of a bishopric. I testify to God that this patient himself swore that he had kept up from the beginning of his injury a series of coitions with a house maid, if not every day at least on every other day. He also drank three or four glasses of malmsey wine every day from the beginning of the injury. In spite of this behavior I believe he was healed by the consent of the Lord.

One of these patients whom I cured at Carpi, whose name was Rumfa, a farm overseer, ate at the time when he was ill salted meat every night in great quantity with bread and honey. He arose at night secretly, took the salted meat without washing it or clearing out the salt and roasted it on the hot coals. He kept a large quantity of honey under his bed and thus he triumphed without anyone else knowing what he was doing. This is the truth.

I have set down all this in order to contradict those opinionated fellows who do not believe the brain can be healed. I ask them to acquiesce in my statements because I am acquainted with the brain, pus, and other marrows. How wounds become lethal and which ones are lethal to some extent has been told above. Nevertheless, I shall add some signs which indicate health or death. Among other signs, when the physician sees fever and some one of the aforementioned bad symptoms with depression of the lips of the wound and with bad color and no pus death is without doubt about to occur.

If there should appear a blackening of the bone which cannot be removed by rubbing it with an iron file the indication is that the black color does not come from medicine but from bad corrupt pus under the cranium. If this corrupts the bone it also corrupts the membrane because it is easier to corrupt the membrane than the bone. When the aforesaid symptoms appear death is at hand. Or if the membrane is black and the blackness does not come from medicine but because the membrane is corrupt then the physician predicts death. This sign is posited by Paul of Aegina, whose authority is cited by Rhazes and Avicenna, chapter on the fracture of the skull, at the end. Note, however, that the bone may become black and not from medicine nor because of corruption made by the pus contained between the bone and the membrane and it will not be so dangerous as above.

It happens that when the cranium is struck in some venous part where those little veins are broken which exist in the porosities of the brain and the fracture does not penetrate the inner tunic of the cranium the blood in the meditullium [*diploë*, the cellular structure which separates the two tables of the skull from each other], that is, in its porosities and sponginess will putrefy. Thus a blackness will be created on the bone which will not be removed by medicine nor is created by the latter nor removed by a gentle rubbing with a file. When the physician sees this blackness without serious accompanying symptoms let him be careful in opening the bone and removing the entire blackened area lest the corruption descend because it can be cured. If there is a delay there will be bad results. It is true that this blood can perhaps be dried up by the use of medicine, especially in a clean and cooperative body. I say this blackened bone will necessarily fall out, that is, be naturally expelled as nature commonly causes other altered bones to issue forth either by means of the pus and medicines or the physician must remove it down to the healthy portion by using a rasp or some other means. It is safer to open the bone and to remove the entire suspected area and to remove it by whatever means if it is possible because if the opening made by the pus or by a corrupted membrane can be cleansed of pus it will probably be healed and the membrane can be cleansed as well.

I have often seen a membrane laid bare in a considerable area and altered on its surface; when this was cleansed the patient recovered. This was verified in my presence and in that of other operators of excellent professional standing whom I saw.

Such cures should not be neglected since now and then some patients are healed beyond expectation, as Avicenna says above. On prognostic Abulcasis said: "Consider the signs and if you see among them some which are of particularly serious significance such as vomiting of bile, loss of mind, cutting off of voice, syncope, acute fever, bulging reddish eyes, and similar signs death will result for those in whom they occur in many dispositions. But if you see signs that are not alarming and you hope to save your patient proceed with his cure" (p. 194).

As Niccolò da Firenze says: "Do not let him become feverish nor suffer intense pain nor heaviness when he lifts his head nor suffer loss of vision. Let him sleep well, be in full charge of bodily motion and cheerful of mind, with good appetite, digestion, and assimilation, whence you may hope for recovery and then proceed with the cure." Hippocrates gives us this opinion when he says: "It is good to be of joyful heart and well disposed toward bowel movements." Niccolò says on the authority of some people that general stupor or delirium if they are great and persevere are signs of death and we have the aphorism of Hippocrates (7.14) where he says: "In the wounding or striking of the head stupor or delirium is bad." The reason is apparent from the fact that stupor or delirium does not occur without damage of the brain; if such damage is great death is imminent. Joannes Mesue in his chapter on stupor says: "And if it results from percussion or a wound it is not cured." Niccolò says the same: "There is rigor [a symptom of fever] in wounds of the head with or without fracture. Similarly in wounds of the noble nerves when it occurs it signals future spasm and death. For rigor in these cases is caused by pus which has flowed from the brain to the nerves, causing spasm and finally death." Note that rigor can occur in some body which has suffered a break in continuity in the head and it will not be a sign of death because rigor in such a body can be caused by something else than broken continuity and by pus and abscess. For it is possible that a continuous and intermittent fever may occur in such a subject and the fever become an illness and not a symptom in relation to the foregoing condition and from these fevers a rigor will arise. And although the rigor is actually due to pus outside the veins and thus occurs in intermittent fever it is well known that it occurs also in continuous fever because sometimes there is so much pus that nature expels some of it outside the veins. Thus rigor occurs in continuous fever; this will be critical and paroxysmal. The paroxysmal rigor occurs according to the nature of the paroxysm, the critical occurs otherwise, sometimes good, sometimes bad. The good is accompanied by good signs, the bad by bad signs.

Note, however, that the good never occurs on a bad day, for example, on the second or sixth day of the fever and on other bad days. And some rigor does not occur unless the concussive involuntary movement of the muscles acts to expel the harmful ill, as Galen says in his *On Symptoms,* V [Vol. VII K.] and throughout his book on *Tremor and Rigor (De tremore, palpitatione, convulsione et rigore).* He says rigor is caused by both hot and cold pus and by the vigorous movement of acute pus upon the members that produce sensation. Note, reader, that although the pus is cold such pus is acute because it is putrid. The Conciliator in his *Problems* 29, first part, says because fevers occur more in autumn and winter and in cold seasons, rigors occur in summer, he gives this distinction: rigor, horripilation (goose-flesh), and chill are certain dispositions which precede the paroxysms of fevers whose pus is contained outside the veins. These are called by a common name for the type, of which Avicenna speaks in *Canon,* IV, fen 1, chapter 6, p. 399v: "Horripilation is a disposition in which the body experiences a diversity of chills and prickling of the skin and muscles. Chill occurs when one feels in one's members and the muscles of the back pure cold or shivering." Rigor occurs when one cannot restrain one's members from commotion and trembling resulting in them from voluntary motions; perhaps it is a strong chill. From a teacher's point of view it is said also that there are four types: rigor from bile, horripilation which is from melancholy, cold from phlegm, and a tremor common to all types of fevers, whence come these verses:

The threefold types: rigor, horripilation, chill.
Chill, phlegm, rigor result when the bile bites.
When the sixth day closes the pores the third brings blood to this one
And the fourth tremor all over the body.

Note also other signs of rigor. Those who suffer from it are of a leaden or livid color because there is an absence of heat in the members and so the blood turns black as though it were congealed, on the authority of Aristotle, *Problems* 1.8, where he says: "Those who are rigid are livid either because the blood is congealed on account of cold and thus it grows black." Note also the other signs because those with rigor and whose extremities are colder than their other members due to the same cause (*Problems* 1. 5) when he says: "Why do the extremities become particularly stiff? Either because they become narrowed and the narrow pores which exist therein have little blood in them, for blood is warm." Fat bodies shiver from a slighter cause than other bodies, according to the same witness (*Problems* 8) because fat people shiver more vigorously due to their fat or because of the magnitude of their reaction or suffering since their extremities are close to the exterior cold and far from inner warmth.

The Conciliator explains this. He says that by magnitude of suffering Aristotle means fat because fat renders animals of easy passibility (or suffering) and senescence especially when it is superfluous fat, as appears from *Parts of Animals* 2.651b 5-10 or because the body is easily passible in itself the fat, although it is warm, by compressing and narrowing the veins impedes the heat from coming from the exterior and because of such a frigidity fat people easily shiver. He also says that those with abundant fat have a moderate amount of blood and thus are cold and shiver easily and are destroyed according to Hippocrates, who says: "Fat people according to nature die more quickly than slender people" (*Aphorism* 2. 44). Those who shiver have another sign, that is, their voices tremble and are not articulate if they shiver considerably, according to Aristotle, *Problems* 13. Hence the tongue of those who shiver is like that of drunken men and is indistinct. Whether or not it is chilled and hardened it becomes hard to move. This symptom is hard to explain. Or the exterior parts are condensed because the inner humid cold flowing together humidifies the tongue so that it cannot function, as was said of those who are drunk. Or on account of the tremor which is due to inordinate shivering with existing movement the tongue cannot articulate and hence is indistinct in its words.

As to what rigor or shivering is see *Aphorisms* 4.29: "Rigors that occur on the sixth day have a difficult crisis." See the same item at *Aphorisms* 58: "A rigor supervening in a case of ardent fever produces resolution of it." On a case of fever with rigor supervening resolution occurs. Hippocrates, *Aphorism* 63, says: "In whatever cases of fever rigors occur during the day, the fevers come to a resolution during the day." This statement is also found in the works of Jacopo da Forlì, Ugo Benzi of Siena, and Pietro Torrigiano de' Torrigiani in his *Plusquam Commentum in Librum Galieni qui microtechni intitulatur,* XI, 3. You now have a full account of what rigor is and which rigor is fatal and which is not.

Rigor occurring from a wound in the head with lesion of the brain or membranes and with pus contained under the bone indicates a weakness of bodily force and consequently death if it perseveres. The same is said to be true concerning contractions arising in the nerves such as from rigor. I say that such pus can also cause paralysis in the same way as was said above, and when the bodily force continues weak death is doubtless at hand, especially if the wounds are dry without pus while nature and the bodily force remain weak.

But if nature is strong it can be aided by art to expel that pus transmitted to the nerves to alleviate and heal the wound; he who has seen this situation can testify to it. I have seen this myself and if serious symptoms are present and bodily strength exists and the lips of the wound are conveniently tumid and much good pus issues forth, there is no need for despair. Hence Hippocrates said that laxity is good, rawness is bad. And again he said that in severe wounds without visible swelling it is bad and such signs not only are true in wounds of the head but of other wounds as well.

Avicenna, *Canon* III, fen 1, tractate 4, chapter 4, p. 184r, says on wounds in the head that separation occurring in the *dura mater* and in the *pia mater* is bad. But when it does not reach to the venters but to the terminus of the thin membrane it is safer and if the incision has reached the brain and bilious vomiting occurs and the fever is not cured except rarely the safer one of these occurrences is that which falls upon the two anterior venters. That which occurs in the two posterior venters is worse, but worse than all is that which occurs to the middle venter. In these words also Avicenna concedes that wounds of the brain can be healed.

The prognostic signs in headaches which indicate ill from another cause than a broken continuity are subjugal or hypochondriac evacuations of urine because they indicate an ebullition of the humors beyond the wound and a superabundant cacochymia [depravation of the humors] which if it is with the wound indicates ill, says Hippocrates, *Aphorism* 4.70. Those patients who have subjugal evacuations of urine have headaches or will have them. Galen in his commentary on this aphorism says subjugal urine indicates a disturbance in the humors, and when the urine which was turbid becomes white without alleviation of the pain it indicates future phrenitis (*Aphor.* 4.73). It is bad for patients who have clear or white urine which appears principally in cases of phrenitis (ibid. 4.72). But if this happens in headache from whatever cause except from eruption of *flatus* and either blood or water issues forth or something passes through the nostrils or mouth or ears the patients are healed, if nature is strong. The first master says in *Aphorisms* 6.27 that in case of headache when pus or blood or water issues through the nostrils it ends the illness. Galen in his comment says: "If abscess or humor causes pain alleviation follows, but if it is caused by flatulence alleviation does not follow." Wakefulness and sleep when excessive are bad in wounds of the head (*Aphor.* 2.3; cf. 7.72). In cases of phrenitis the flux of hemorrhoids is good. See *Aphor.* 6.11: "Hemorrhoids appearing in melancholic and phrenitic afflictions are favorable." In cases of frenzy, or phrenitis, watery urine is bad, says Avicenna: "He who has watery urine in his phrenitis does not escape such an illness. Hippocrates says in the ivory capsule [*Prognostics*] if a blister arises on the thumb of a person suffering from phrenitis it is a most certain sign of death (*Aphor.* 7.51?). When the brain is attacked by *sphacelus* (ibid. 7.50), that is, incipient mortification or gangrene, the patient dies within three days, but if he escapes this he is cured. But if lethargy takes place and sweating increases and lethargy is not reduced this is a sign of death, also if the sweat is cold. Philonius says if leeches when carefully applied to the forehead do not cling to it this is a sign of death. If sternutatories are applied and do not produce sneezing the result is mortal. Rhazes, *Continens* XV, says if someone is struck upon the head and from the blow syncope and vomiting result and the blood ceases to flow and there is no recovery from syncope he will die. Do not overlook that sign from the Hippocratic face, whether it is that of a healthy man or not, (*Prognostics* 2; cf. Lucretius 6.1190 ff.), if the nose is sharp, the eyes hollow, the temples collapsed or flat, the ears cold and contracted and their lobes turned out, the skin about the forehead rough, distended, and parched; the color of the whole face green, black, livid, or lead-colored. These signs on the first day without a considerable flow of blood preceding indicate ill for they show that the brain is suffering and the membranes also without in the three days preceding wakefulness or solution of the stomach or vomiting or fasting. If these symptoms occur it is bad and evil necessarily follows. When good symptons appear, that is, when the patient resembles a healthy man good does not necessarily follow because later there follow bad symptoms and death from various causes. Nor should it escape you that very often in cases of head wounds the patient reaches the twentieth or twenty-first day of his illness without any bad symptom. Around the end of that time there supervene very bad symptoms and this happens most often from pus retained deep within the wound.

I wonder and some others do also why such symptoms do not supervene earlier which according to my sound judgment do not come to a patient when he is stronger because perhaps then little pus begins to collect and descend from the upper regions through the pores of the cranium or from the bad regimen of the patient's drink or food or air from his emotions or perhaps from a physician operating improperly or perhaps from the strength of that day among other critical days and from similar causes. On this day and other days see the Conciliator, who notes many things concerning the crisis (*Differentia* 104) or because from the beginning the pus has run into the place, which before had not putrefied perhaps because of the medicines applied or the strength regulating the pus and then it begins to putrefy and bring on fever and the predicted symptoms by which death is caused.

Pietro D'Argelata in his book on skull fracture says: "And, dearest brothers, in fracture of the cranium you should not make your judgment by the pulse concerning death or salvation because you will often be deceived" [*Chirurgia*, Venice: Ben. Genuensis, 1480, f. 43b, Capitulum de signis fracturae cranei]. I wonder at this statement. I say the physician should always take the pulse of his patient. By it salvation and death are recognized; indeed, both are better recognized by means of the pulse if the proper requirements are preserved with care and prudence.

I remember and have at the present time here in Bologna many learned men who are witnesses to the fact that I made a prognostication of the precise hour of death of a certain son of the noble lord Jacopo Maria de' Lino, having observed the rule of the rising and falling pulse beat handed down by the physicians. I made this judgment by estimation and am unable to set down the process fully in writing except that I proceeded as follows. I first measured the strength of the pulse to my touch and visited the patient once each hour for six hours, noting that his pulse grew steadily weaker. Then I took into consideration at the time the status of his symptoms and fever and by calculating his dwindling strength and comparing his presumable condition on the critical fourteenth day of his fever I judged by such means that he would die between the second and third hour of the night because of the six days before since that was the hour of the symptoms and the fever. My prediction was correct; I would most gladly have made a contrary judgment.

Let our Argelata therefore be silent and let him and others say that the pulse indicates the same symptoms as the face does, for a good face is not always a good sign because of the aforesaid reasons regarding the pulse, for a bad face and a bad pulse indicate ill as well, and perhaps Argelata thought so too. Yet his statement on the subject indicates otherwise.

Thus for the honor of the art of medicine let physicians beware of making a precise or particular prognosis, but let them repeat that golden saying of Damascenus in his *Aphorisms*: "If you are questioned as to your prognosis always reply quickly that the case is in doubt." And above all let this be said in the presence of the general public lest he presume to make some prognostication except in the manner described because idiots understand one thing in place of another. Thus if anything goes wrong with the patient as is possible his death is imputed to the physician alone. The physician should not forget another aphorism of Damascenus. He says: "But you must promise recovery to the patient nor ever allow him to lay hope aside, nor should you yourself despair, for the complexion or condition of his body will always have an effect on his mind" [Serapion the elder].

In prognostication you should pay attention no less to the eyes than to the face of the patient, says Hippocrates [*Prognostics* 2). If he shuns the light and sheds tears without wishing to do so as though through suffocation and one eye appears less large than the other and he appears to squint and the whites are bloodshot or as if they have black veins in them or there is a pallor in them or they stick out too far or become very hollow and the whole face appears horrible you should judge all these signs to be dangerous and fatal.

You should also observe the appearance of the eyes in sleep for if the white alone appears from below the eyelids nor is this due to solution (death) or through themselves or the use of cathartics or from habit you will fear the signs of death, and if the eyelids are contracted or livid or the lips are similarly livid or the nostrils distorted, by these signs either alone or with some of the other symptoms you will judge that death is very near with the conditions described by me above. From the manner in which the patient is lying one can also judge a good or bad symptom if it is contrary to the position assumed in bed by a healthy person.

It is now time to close the sluice gates of my discourse [cf. Vergil, *Eclogues* 4.111] on prognostic signs. Let them go to more abundant sources of knowledge who desire more information; I must now turn to the cure for whose sake I have told you what has gone before.

Chapter XIV

Care of External Lesions of the Head

Since large and small wounds occur to the head as well as contusions and perforations made with a spear, dagger, or arrow also without lesion of the cranium we must cure them first beginning with those which are less serious so that nothing or at least very little may be left untouched on the subject. Pay attention therefore, my reader, because one cannot be confident in regard to contusions as one can be in regard to perforations and incisions because physicians and patients are continually deceived by that form of wound. Contusions also occur in the head without lesion of the cranium and pericranium, but they are more difficult to recognize than incisions and perforations.

To recognize a contusion you should consider the cause of the blow.

Some contusions occur with a disruption of the skin either large or small although a large one rarely happens without reaching both pericranium and cranium. Some occur without a complete break in the skin although it is injured in the majority of cases since it is viscous, dense, and hence not easily ruptured as if it were hard glass without viscosity like a bone.

Let us begin therefore with contusion without disruption of the skin. I say that he who wishes to cure correctly lesions of the head both major and minor must consider the total strength of his patient, whether he is strong or weak, his age, region, and the season of the year as well as his preceding regimen. We must consider if his head is strong and if he is accustomed to endure pains of the head and from which cause, also what kind of complexion he has in general and specifically the complexion of his head and how he may conduct himself during the cure according to prediction, however minor his wound.

Therefore the physician in attendance upon a minor contusion without disruption of the skin should immediately shave the hair of the head, humidifying it with rose oil and wine or common oil. The widest area of the shaved portion of the head should be more extensive than the contused spot. Since in such contusions without disruption a swelling is instantly formed more or less according to the cause of the injury whether strong or weak this swelling should be cared for in this manner.

First, let a diversion be made by blood-letting, cupping, or massage of the parts near the head, that is, the shoulders descending to the arms and down the back to the legs. If the body is plethoric it should be evacuated before the massage is carried out. The reason for this is sensible. First apply some local medicine to the site of the contusion so that the patient can be treated with the aforesaid diversions without disturbing him.

Nevertheless, anyone should be well informed that it is impossible for the physician to reach a case of contusion as quickly as he wishes for he will find that pus has already flowed into the site of the injury.

Therefore he must not proceed with purely repercussive or repellent means because this swelling indicates an abscess which has grown considerably in reference to the flow of pus. No one should doubt that this is an abscess when there is a swelling and a break in continuity as well as a bad complexion. As to this doubt I do not wish to waste any time. Nor should repercussive means be used in the treatment because we have a universal canon or law that an abscess created by a primitive cause ought not to be treated repercussively on account of the closing of pores and thus a greater consolidation of pus in the area affected. Nor should we make use of these repellents at the first hour of the treatment while the pus is still in motion but our purposes ought to be mixed. Working together at the first hour, the attendants should take an egg with white and yolk together, because this does not require for a constriction of blood [hemostasis] the use of the white alone. With it they should mix rose oil, soak a piece of tow with this mixture and apply it to the area affected after first smearing it with rose oil. This application should be used twice on the first day; it is very effective because neither blood nor anything else impedes this change of application and thus the pain is reduced and the part affected is treated with repellents of egg and oil. This is more appropriately a comfort rather than a repellent for the area and by means of the yolk of the egg a gentle resolution is caused since it is of temperate complexion although some say that the egg yolk is warm and the albumen (or white) is cold and the entire egg is temperate. I agree with this opinion yet I say that the yolk is not very warm with a heat that may cause resolution. Thus I proceeded in this manner for days and it always succeeded for me.

On the second day's visit add some cumin to the mixture and apply it in the form of a hot poultice. When the fourth day has elapsed take honey cooked according to the art, i.e., carefully, and place the cumin seed into it. This should be applied to the head as a poultice to the end of the cure. This will be completed conveniently within ten days at the latest or a little more. Ordinary lesions do not require so much time, usually only fourteen days at the most according to the word of the physicians.

Another method of procedure is as follows. At the beginning apply rose oil or camomile infused in three or four applications, one upon the other, or tepid rose oil alone at whatever time so that it may work more quickly on the wound. In the winter, however, a warmer embrocation should be used and retained with a bandage conveniently attached. Proceeding thus, when the fourth application has been made some poultice or wax to resolve the wound should be used until the cure is completed. The oily bandage should be changed twice or three times a day according to need, for a constant pain in the area of the wound requires a frequent change. Not only should the bandage be dipped in oil but an embrocation of other oils which will penetrate more deeply should be used. If the pain is very severe the physician should consider its cause and seek to alleviate it. If the cause is pus collected and consolidated in the area of the wound which causes great pain the physician should use emollients and pain-killing drugs such as a decoction of althea, flax seed, and fenugreek as an embrocation, thickening the poultice with oil of camomile or oil of anise to which chicken or duck fat or oil of sweet almonds has been added. Such preparations open the pores and really soothe pain.

Chicken fat, as I said, soothes pain and also serves to heal the wound especially if it is clean and the pus has run off. Hence Galen says, if I remember, in his chapter on difficulty of hearing where he scolds Herophilus and Apollonius for their medicines for earache which are worthless [Vol. XI. 795K.; XII. 653 K.], that chicken fat is suitable.

If indeed the chicken and duck fat is used on a body which has been evacuated of pus and no longer flowing with it to create an inflammatory condition of the humors it assists in a double manner, mitigating and curing. But if the pus is still flowing it does not change the disposition although it lessens the pain. Let all this be done without omitting universal remedies including blood-letting, cupping, suitable drugs or clysters as the physician can and must use them. It is helpful also to apply fleece of hyssop with some of the aforementioned oils when the pain has ceased, beginning with the weaker ones. The pus must be resolved and this is a light resolvent. Recipe: three ounces of humid hyssop, two ounces of oil of camomile, and as much as is needed of powdered wormwood and betonica. Make a poultice with these ingredients. Another stronger recipe includes three ounces of turpentine, two ounces of humid hyssop, one ounce each of betonica and *mater silvae*, one half ounce of cumin. Make a poultice. Turpentine along with cumin is admirable or turpentine with the same amount of yellow wax and a sufficient quantity of cumin added. Make a poultice and apply to the wound. Another recipe: take equal parts of powder of salvia and marjoram, gum Arabic, aromatic reed or calamus, red roses and wormwood, boiled wine, a little honey and turpentine. Apply as a poultice. Another very good preparation is in the form of wax. I use this and I call it wax of betonica. Take four ounces each of turpentine, pine resin, and fresh wax, one and one-half ounces of betonica powder, one-half ounce of mastic incense, half a handful of *mumia* (dried human flesh). Make a mixture of these and apply to the scalp and head. Place it on the site of the wound for eight days before removing it. Then change and make a fresh application. You will see a marvellous improvement if you apply it immediately before severe pain has set in. Another tried and true recipe of wax: take three ounces of turpentine, wax, pine resin; liquefy them and add half an ounce each of sandarac incense and mastic. Use as before applying it to the scalp or a piece of cloth used as a medium. Suitable also in these cases among other medicines is my human wax, so called. I shall describe it later. It has no equal especially if applied immediately after the wound is received. After the fourth day these resolvents are usually applied, but in the first days one should proceed with oils or egg as I said at the beginning. Furthermore, there will sometimes be pain due to the hot pus which has run into the site of the wound. It may be choleric and then very cold remedies are in order such as rose oil with juice of semperviva, alchachengus, lettuce, nenufar, portulaca, psyllium, polygony, twigs of grape vine, and unripe grapes especially in very warm regions and in the choleric season and in a choleric complexion and the summer time. Avoid the juice of poppy and mandragora for they cool the patient and harm him. Very styptic or astringent drugs are also harmful. But if they are needed a little of them should be added. Thus we should mingle a little of tart pomegranate juice or of citron or medlar. Pomegranate juice is better. The juice of the wild gourd is also helpful.

If we fear that some bodies will be greatly cooled by these herbs such as the bodies of women, eunuchs, infants, and those which have soft white flesh unaccustomed to the sun we should administer oil of camomile instead of rose oil. All these are Galen's remedies in *De Locis Affectis* (Vol. VIII K.) II, chapter on headache with inflammation, where he says that headache is due to the course of humors and vapors to the head.

The aforesaid remedies are beneficial in all the aforesaid cases. It is also useful to administer some vinegar with these remedies so that the power of the medicine may penetrate deeply or mix the vinegar with the oils either in poultices or with waxes. Vinegar is especially convenient where the skin is not broken in any way or at least when the *dura mater* is not laid bare, as Serapio says concerning the cure of headache resulting from percussion: "If the hard retal covering *(dura mater)* is laid bare we should pour warm rose oil upon it. If it is not laid bare and the *dura mater* seems healthy we should add a little vinegar and apply the mixture to the head so that it penetrates to the *dura mater*. If there is an abscess with pain we should omit the vinegar. However, if there is an abscess in the skin of the head and the membrane surrounding it upon the *dura* without great pain then it is possible to use rose water and a little vinegar."

Haly says the same in *Theorica* V, chapter 10. Vinegar does great harm to the nerves and head if there is a wide avenue for its penetration such as when there is a wound and a disruption in the head. Nevertheless, Celsus on skull fracture (8.4.9) uses vinegar as praiseworthy for the membranes. I am surprised at this statement since vinegar causes pain because of its acrid nature. All the other authors avoid vinegar when the head suffers from pain and abscess. Avicenna, however, and some others use it mixed with water even when the cranium is broken for the purpose of restraining the flow of blood as Celsus does.

Galen (ibid.) concedes that vinegar can be used even with a head wound, but I say he concedes this only if the bone is not laid bare and if the wound is not large. According to this way of thinking, rose oil is applied to the thick membrane as in those cases where some part of the bone is cut away and used pure and tepid. But when the bone is not denuded if we wish the rose oil, the cranium being healthy, to penetrate through the *bregma* to the membrane then we should mix in some vinegar to bring the oil back to full strength in the mixture. When Apollonius bade the vinegar to be mixed with rose oil as a first application he was wrong for the skin of the head or of the pericranium which is next to it will be greatly inflamed. A small amount of vinegar only should be used. A large amount will produce a violent pain.

But there are a few people who believe that Galen allows vinegar to be used when there is a large disruption on the head. If this is true, I do not agree with this opinion because in my experience I have seen vinegar produce great harm. Nor is Galen's opinion very clear according to his text, where he speaks concerning a wound. He says vinegar helps at the beginning when mixed with rose oil. At later stages of the cure if it is mixed with medicines as in the aforesaid case it makes the medicine penetrate. This is well known to all. These remarks should suffice concerning a light contusion of the head without breakage of the skin.

If the head is contused with rupture of the skin yet without cranial lesion I call this a lighter contusion first because the contused blood has free exit and is more easily resolved perceptibly or imperceptibly, for if there is a wound the blood must necessarily find an exit. If it does not have sufficient exit the physician can rub the lips of the wound with something rough and accomplish the purpose. This method is sufficient if the veins are not large.

According to Avicenna this blood is of much benefit for in *Canon* IV, 4 he says a flux of temperate blood in a moderate quantity is helpful in wounds as it prohibits abscess, stoppage, and fever. This contused blood is resolved better into pus and vapors as is clear to those expert in wounds.

Therefore when general precautions are taken one must discover whether this lesion has affected the pericranium at least when it is laid bare because sometimes that part which is above the pericranium is contused, later putrefies and falls away and thus the membrane is disclosed. If it is only slightly altered it can be saved with appropriate medicines and can become covered with a scab. But if the pericranium is injured recognizably by a sense and judgment the cure should not be postponed and requires the services of a legitimate physician because there is danger lest harm come to the *dura mater* with its ligaments connecting throughout.

At the first visit of the physician a cure should be undertaken with egg white and a piece of tow and a tent or small roll of lint to dilatate the break in the skin so that medicines may be freely introduced into the wound and so that the pus may not be retained. If the skin is broken as often happens in such a case in some area and even when it is not broken but only abrased so that the pericranium is not exposed, the physician considering the strength of the wounding object and the size of the break or abrasion doubts that the pericranium is injured he should immediately take a razor or another instrument and open the entire contusion with a triangular or quadrangular incision. Operating thus he may discover an unforeseen lesion in the cranium since he may make an accurate judgment more by sense than by imagination. He should not at the first visit remove with instrument or by hand the pericranium from the cranium but only the pericranium from the contused flesh. At the second visit he may ascertain whether the pericranium is contused. If there is doubt he should then separate the pericranium from the bone with an instrument or some other means so that he can see what is beneath it. The operator should not hesitate to do this although it is a sensitive member because there is little pain in it due to the prior severe contusion. I have done this many times and I have seen it done successfully by other operators. If there is actually a lesion beyond a doubt the pericranium should be left in place because it will either be covered over with reparative flesh (a scab) or will fall away in the process of being cleansed as is required by the cure. When this operation is completed the wound should be filled with tow from which tents are made without heat which are the same as those soaked in egg white and placed in the wound in cases where a great flow of blood is not to be feared. I take the white of an entire egg beaten with a moderate amount of rose oil because it soothes the pain better. It should be left in place for one day until the tent is well dried out because when the lips of the wound are more dry they remain more open and the physician can operate better on the open rather than the closed wound and with less pain to the patient. Physicians should always observe this procedure when they intend to perform trepanation or another operation because when the lips are well opened contact with the instruments and thus damage on the lips is avoided. This contact causes pain which is difficult for the patient to bear nor can he endure such operations because he is forced to suffer more and pain may cause his death.

Every operator should remember that in such an operation sometimes a prominent vein in the head is incised. Constructive powders and means for reducing the hemorrhage should always be at hand. If the physician does not doubt that the pericranium is injured but he finds multiple wounds and abrasions in the skin he should make one only out of all of them by gently opening them with an instrument and placing a tent in each to keep it open so that the pus may be freely purged. As I said above the first step in the cure is use of the egg and tow. At the second visit the physician should apply other local remedies for three purposes: to soothe pain, to prevent pus from forming in the member and creating an abscess, and to digest the collected pus and to bring the lips of the wound together.

That rose oil soothes pain is known to everyone. It does so by opening the pores with its oiliness. It comforts the bodily member with its astringency because the roses are not in full bloom and they are thus mildly astringent, dry, and aromatic. With its oiliness and mild heat rose oil disposes of pus both hot and cold. It cools the hot members and warms those which are cold. Its disposal of pus is according to the physicians nothing less than an equalization of quality and substance in the humors. Rose oil is also useful for abscesses as they increase. In contusions there is always a swelling on the first day with subsequent increase. Rose oil is of special benefit, as Galen says in *On Simple Medicines* III, fifth and last chapter, speaking of roses and of rose oil. He says rose oil lies between oil and roses in its nature and hence is a better medicine for abscesses as they develop since it rectifies them as I have shown by experiment. The cause is described in Galen's *De Ingenio Sanitatis*. Rose oil is a combination of two simple medicines and should be administered twice at half hour intervals at first in order to prevent the pus from forming and to resolve it without a griping pain. It should be used at the time of the increase and ascension of the pus in order to remove it and to resolve what has collected. This advice when heard by a man who does not heed what I have said as to reasonableness in this matter perhaps will not accept it nor examine its truth.

But since these two preliminary kinds of medication are necessary I do not know anyone who in his ignorance would go so far as to deny this explanation of their use and not receive and employ it. It is necessary that the significance derived from the illness itself and the medicines administered at the time of the increase of the abscesses and their rising should indicate two contrary developments. One is the sudden change due to the astringent effect of the medicines which consolidates the substance of the member to which the substances which soften and resolve it are applied. At the time between the beginning of the abscess and its increase it is not good to use medicaments which would prevent this development and cut off the attraction of pus with resolvent medicines. Different medicines should be used at different times in the treatment of an abscess. Astringents should not be used at the beginning of the treatment nor resolvents at the time when the abscess is forming. Rose oil lies between the two extremes. See Galen on how beneficial is rose oil if you remember what has been said as to its use. It is one of the better medicines for head wounds for it soothes pain and comforts and relaxes the members. It is administered in pure form by pouring it on pieces of cloth and lint. The entire head should be anointed with it especially during the entire time when the abscess is increasing.

But some will say that rose oil does not help when used with wounds where there is no contusion and consequently no swelling because Avicenna and other doctors use rose oil also in the exposure of members so that an abscess may not be formed. In fact, Galen in *Therapeutice* VI, the end, praises it as a sedative in head wounds and says the Roman physicians use it. One must say that rose oil is helpful in other wounds although they have no abscess for head wounds and those of other members also require sedation of pain, repulsion of humors from the member, comfort, and some consolidation of the pus contained in the lips of wounds. Rose oil is particularly useful at the beginning of the treatment in large wounds and during the ten days which an abscess takes to reach its peak. This applies to wounds which do not accompany other illnesses or some other concomitant which prevents a cure. I shall speak more in detail concerning this mode of administration of rose oil in its place later.

Although rose oil is better adapted for use in large wounds it is beneficial also in small ones, since they are more easily cured. My general remarks include small wounds only for the sake of more inquiry into the truth since these medicines are usually for use with fractures of the cranium.

Note that many people use rose oil and egg yolk from the beginning in treating these wounds. They apply it in the form of ointment. I do not much approve of this since the egg is easily subject to putrescence and we should avoid this as much as possible in head wounds and prevent the membranes from putrefying. Therefore I prefer pure rose oil. If, however, the egg yolk is used it is primarily for consolidating the pus in the lips of the wound, but it should not be allowed to penetrate to the bare bone. It should be employed externally in head wounds where I have seen it succeed many times in its pure form.

Some people use turpentine mixed with egg yolk from the beginning of the treatment. This is not a good method because turpentine contains an astringent, nitrous, and aperient quality. There is not in it a repulsive force necessary for wounds of the head as is clear upon consolidation although turpentine is among the better medicines for wounds of the nerves. None of the ancient physicians used it for head wounds, although some today have used it with good results. I still prefer rose oil. Even an erroneous method sometimes succeeds.

Others use hot and dry poultices from the beginning, which I do not approve either. Some use certain hot distillations with water of life *(aqua vitae)*. I detest this method as well although some physicians continue such treatment not only with detrimental local applications but also with a heavy diet of wine and meat.

When the wound is free of abscess the flesh should be restored by bathing it in honeyed wine and with the application of ointments which generate flesh, such as the king's ointment and the ointment of Rhazes, that is, the usual yellow ointment or my own head ointment described herewith, called honey suckle ointment, and powders which generate flesh such as the powder made from myrrh, dragon blood, aloes, farina of orobus and sarcocola, incense, myrtle, and such like. When the flesh is replete with these some medicines which form scabs should be administered such as the ointment made from *minium* or litharge [semivitreous lead oxide] or *tutia* [zinc oxide] or white lead [*plumbi subcarbonas*]. When these unguents are combined in the form of a wax they should not be applied unless the wounds are quite replete with flesh. But since sometimes the flesh grows to be superfluous the physician should remove the excess with unguent of the apostles or with sugared alum or burnt alum which is by far better than those aforesaid. For burnt alum lightly sprinkled dries out the excess flesh and puts a scab on it when some of the unguents mentioned above are used.

I have often used some of these waxes or human wax or betonic wax, which is outstanding up until the scab is completed over the wound. After that I place some unguent on it for eight days so that it may increase and grow hard with more callous flesh. This is the end of my remarks on head wounds and contusion without fracture of the cranium.

Since it also happens that the head is often wounded without lesion of the cranium but with damage to skin and flesh I have decided to describe their care. After general measures are taken, the blood checked, and the pain brought under control a light cleansing medicine without a stinging quality such as rose oil and rose honey should be applied, decreasing the oil day by day until one reaches the pure honey. My head ointment is also outstanding. The king's ointment is also more or less effective.

In reference to Avicenna, *Canon* IV, 4, on the growth of flesh in ulcers this is done more conveniently but more slowly with poultices, with powders more swiftly and easily, as Dino says. Powder is less capable of penetration. Hence poultices and unguents are preferable for better penetration to any part of the ulcer. Powder should therefore be applied only externally.

If the head happens to be wounded in such a way that the flesh is not moved aside but a large incision has been made in the skin but not totally removed from the place of the wound so that the skin is still alive the physician should consider the shape of the wound and sew it up if necessary in its lower area but leaving a hole in it for the insertion of a tent so that any bloody pus which is generated may be easily cleansed. This applies to wounds which are not at the top of the head since pus cannot be removed from that place as easily as from the sides. But the top should be kept open with tents according to the art without sewing up the wound entirely. You understand, however, that such wounds are without cranial lesion since these are cured just like simple wounds by the use of general medicaments, shaving the head for local applications, with rose oil and the juice of unripe grapes into which a fourth part of turpentine or pine oil is infused at a warm season. It should be more warm in winter. Anoint the wound with it and place a consolidating powder on the suture (if sewing is necessary). This preparation is made of *mumia*, dragon's blood (*calamus rotang*) in tear (lacryma or sap of *vitis vinifera*) and incense and is also a preservative. It has a marvelous result in preserving the sewing and consolidating the wound. There are some who add the hairs of a hare and mastic, some who add myrrh but double the dragon blood and *mumia* and thus consolidate such wounds quickly but with a suitable bandage to help create a scab as well although it is not easy to place one on the head because of its round shape even if the physician is competent and legitimate. Although this method of procedure is somewhat faulty as I have seen it followed many times and have followed it myself nevertheless such bandaging is more successful in other parts of the body.

There are some who do not approve of sewing up wounds in the head when neither cranium nor pericranium has been injured because they say such wounds are rarely consolidated even if they are simple and that there is great danger if bloody pus is generated therein that the membrane and the cranium will become infected. They say that the lips of the wound should be brought together not entirely with a light bandage. The wound should be kept open with a tent. This method results in an easy cure, they maintain. I reply that I have seen many similar cures with the use of suture and bandage with an orifice left open in the lower part, as I have said. This method succeeds quite well when used with care.

This suture can, it is clear, be performed on exterior wounds, but it can be used on wounds penetrating to the interior, for Rhazes, *Continens* XV, chapter 5, at the end, on the authority of Tabri [Ali ibn Rabban Tabari, who wrote *The Paradise of Wisdom*, a medical encyclopedia: 850 A.D.], says if the bone is fractured and the membrane is exposed which is upon the brain an effusion of warm rose oil should be poured on the fissure; then the ends of the wound should be sewed up, some of the powder described above sprinkled on the wound, and a bandage soaked in egg white placed to adhere upon it and then lint infused with wine and oil on every part, thus applied once or twice a day.

Serapio says about the same in his discussion of headache from percussion: if the bone appears to be fractured then it is not possible for it to return to its natural condition. Means must hence be contrived to form a scab with warm rose oil, proceeding as above with suture, powder, bandage, and lint.

The powder is Rhaze's recipe: aloes, vitriol, camphor, dragon blood, balaustine flower [*Punica granatum*, used as an astringent and made from the rind of the fruit]. Serapio's recipe is as follows: aloes, sarcocola, one ounce each; farina, incense, chaff of incense, that is, of the skin of incense, two ounces; dragon blood, one half ounce. Some people use equal parts of all ingredients.

Nonetheless, I believe that suture as used by these authorities is dangerous even with a wound on the side of the head with an open orifice as is done with other wounds especially when there is a large fissure in the cranium. In external wounds it can be done as appears from what has been said and must be said. Physicians using a suture should do so only on the sides of the head and not on top where bloody pus is easily retained whereas it is drained from the sides. One must be careful too of supervening fever if the wound becomes abscessed and retains pus. Although some pus is generated in the area of the wound and retained by the suture the patient will not die if the cranium is not exposed and care is taken to extract the pus. Let sewing take place therefore if it is needed and proceed as prescribed above.

Because it is true that pus retained by the suture is not so much to be feared as some say we see many abscesses especially on the heads of children in which there is much pus, but they do not die on account of this not even when they suffer fever. I have lanced more than a thousand such abscesses and the patients were cured. I insist so much the more that pus is not to be feared when I see children endure it without ill effects especially since pus is more apt to injure children because of their fragility and also for other reasons which for the sake of brevity I pass over in silence.

Note, however, my reader, that I said a suture is to be made when the bone is not injured nor the pericranium since if in such a case a suture is performed when the bone is injured death may result. Then we must lay bare and open, not close and sew up the wound.

Nonetheless, I swear to God that I witnessed a case which I scarcely dare to speak of because of its extraordinary nature. When I was a young man it happened at Carpi that a certain Bernardino Spacini wounded Bernardino Vicentino, both of them soldiers of the noble lord Marco Pio of Carpi, with a weapon commonly called a *ronca* [pruning hook] which totally split the frontal bone from top to bottom at the eyebrows so that the cranium was united with the skin of the front which was not in turn completely separated around the eyebrows but only incised in the upper part and the sides in such a way that the bone and the skin in front covered the eyes of the patient. My father attended the wounded man. He immediately removed the bone from the frontal skin. The bone was as long and wide as the entire front, and the *dura mater* was in no way injured. When the bone was removed my father sewed up the skin of the front without leaving any opening and applied thereon white of egg with tow. At his second visit he applied my wax called human, described below, and changed it once a day. In ten days the patient was cured as if he had suffered only a simple wound. Certainly miracles sometimes occur in nature. This patient lived a long time and the movement of diastole and systole was continually visible in the place where the bone was lacking. I have described this case in order to make physicians alert in curing the sick since sometimes great things occur for them whether by reason of the physician's skill or because of the patient's strength by way of his horoscope or as Celsus says above (*De Medicina*, 8, proem 1) a great improvement occurs by fortune. Let physicians be prompt therefore to operate and not desist from necessary action for the aforesaid reasons given by Avicenna in his chapter on extracting arrows, cited earlier.

If the wound does not require sewing it can be cured as a simple one. But since such simple wounds often develop into an ulcer and become composite since they are altered by the air then they should be handled as composite wounds. Let physicians look them up in Avicenna on wounds and ulcers, a special chapter. Here he treats cranial fracture especially. Also if the wounds are made by an arrow or an object which perforates they are cured by a method involving simple wounds because they are called simple, not composite, if they are without lesion of the cranium and pericranium. If they are fresh wounds without alteration by the air and without another cause mixed either with some illness or symptom they are simple.

Abulcasis [*Methodus Medendi*, etc., Basle: H. Petrus, 1541, p. 195] praises rose oil with styptic wine such simple wounds. Galen, *Catagenis* III [*De compositone medicamentorum* (Vol. XII-XIII K.)], as is said in *Continens* XV says if the wound is moderate it is cured with myrrh and aloe and the condition of the abscess is rendered secure. Serapio says if the wound is in the skin of the head sprinkle some cassia on it and it will be healed but if it is penetrable to the bone it will be cured with myrtle, myrrh, incense, and aloes. It should be bandaged and not changed for four days. Avicenna says in his chapter on skull fracture the cure of head wounds which extend to the pericranium is the same as that described in the chapter on ulcers and earlier in the book. Before he deals with ulcers he discusses in these chapters the approved method of curing them in the head and also other members. Likewise Avicenna, *Canon* IV, fen 4, tractate 1, chapter 12, p. 448 r, on the care of ulcers in the head, the last chapter on ulcers, says: "The care of the bone in ulcers and what happens from their serious symptoms has already been described in the chapter on bones and the means of producing flesh in them and the medicines which dry them up by sprinkling powders over them made from aloe, myrrh, olibanum, and dragon blood. Similarly the light medicines described before should be placed on the wounds because if there is a flow of blood it is cured with what I described in the chapter on the flow of blood."

Abulcasis says if such wounds are small powder them with one part olibanum, two parts of dragon blood, three of quick lime; let the wound grow together and place the powder on it. If there is no abscess it will be cured quickly by quick lime alone, but it is best to use this powder more in the winter.

Galen also in *Catagenis* [*De compositione medicamentorum* (Vol. XII-XIII K.)k] praises farina with wool fat (lanolin), warm hyssop, and mountain mint. Niccolò says it sometimes happens that in a contusion the skin is separated from the cranium. Physicians heal it and cause it to adhere in its place. Crushed olive leaves with the best wine are used as a poultice. Zohar [Avenzoar, *Theizir, Morbos omnes*, etc. Venice: O. Scotus, 1542] said if the wound or contusion reaches the exterior membrane of the head and the pain does not cease with the application of rose oil with a piece of wool add a half measure of oil with egg yolk. He said such a lesion of the membrane is to be feared and cared for in order not to give rise to an abscess. A decoction of acorn shells or horse tail in water with honey or wine should be made; wash the wound and place on it an unguent of palm oil.

Some people praise wine with salt. Others make a poultice with cumin, anise, and laurel berries, powder of incense, and mastic. They mix a little of these ingredients with much bran and wine. They cover the entire head with this mixture.

But I have seen many Germans fill the wounds, even large ones, with salt alone and the patients are healed in a short time. I wish what I have said to suffice on the cure of external wounds and lesions of the head. If I have said something above which also applies to the cure of internal lesions I have done so because there is no great difference between medicines suitable for both kinds of wounds and because sometimes the physician is aware of an external lesion when it is perhaps also internal. It is not absurd to use these medicines both inside and outside the head as is clear to an experienced and expert physician.

Since the cure of the broken continuity of the exterior of the head has been taken care of let us come to lesions of the inner parts, first with diet, then drink, and manual operation of surgery.

Cure with Diet

To begin with diet which is nothing other than order I say that it includes regimen and nutrition. There are six non-naturals as they are called by physicians. If a man uses them as he should in both quantity and quality he will preserve his natural affairs in time and in order. If he does not do so he will become ill and if he is ill the illness will be continued and increased. The witness to the facts is Haly, *Theorice* V, 1. He says that the non-naturals are certain requirements for the support and continuance of human life. The first of the six is the air which surrounds all bodies. The second is motion and rest. The third is the kinds of food and drink, the fourth sleep and waking, the fifth digestion and constipation, the sixth the emotions. Under natural evacuations are listed bathing, coitus, voiding of urine, wiping or blowing the nose, and similar removal of effluvia. Under emotions we have joy, anger, sadness, worry, and fear. Although these factors of life are not natural in the sense that they are original with the generation of man they are not entirely alien to him. If a person uses them as he should and as is just and necessary in quantity and quality, time and order, he will preserve his natural condition and strengthen his health until his natural death. If he behaves otherwise than he should in these matters he perishes and if he is already ill his illness is worsened and increased. Tursianus [Tursiani (Trusiani), *Plusquam Commentum*, etc., Venice: Philippo Pincio Mantuano, 1512] in his commentary on Galen's *Techne* II, 7, says only two aspects of the non-naturals should be observed, that is, the quality and quantity required at a given time. He reduces the substance and the means of what must be provided to these two because the time of administering medicine is unimportant except to observe it properly as a symptom of the illness involved. Galen, the leader of physicians, in *Techne* III, fifth commentary, lists all the preceding six non-naturals as does Avicenna, *Canon* II.

Regimen of Air

The cure of wounds of the head through diet must begin with the air as set in order previously by Haly and others. I say that warm air must be chosen whether warm by itself or by accident because everything cold is exceedingly harmful to the members of the head according to Avicenna, chapter on skull fracture.

Be careful to avoid cold on the lining and elsewhere, he says. In every disposition one must be careful of cold even in the summer since there is great cause for fear in it. Coldness of the air can cause apoplexy and many other very serious results, some of which I have mentioned above in their place. It can also cause a hot abscess by itself or by accident because with its biting quality it sets the humors in motion which flow in the head and form an abscess. Cold is biting to ulcers, says Hippocrates, *Aphorisms* V, 20, and Galen, commenting on this aphorism, says the sense shudders at what is contrary to it. Where ulcers are due to the absence of skin the cold easily penetrates to the sense and bites the members thus creating an agitation of the humors and finally an abscess, as above. Rigors, spasms, tetanus, and fevers result: *Aphorisms* V, 17. Cold is also inimical to the nervous members (ibid., 18), to the bones, teeth, brain, and spinal marrow. Warmth, however, is beneficial. Among other forms of harm it brings to the aforesaid members, which are by nature bloodless and cold, the chill suffocates, exterminates, and extinguishes the natural heat.

Reader, when I say the cold is harmful to ulcers and the aforesaid wounds please understand an actual cold, not a potential one, for colds are alike and the complexion of the head is cold. Because in the aforesaid ulcerated members there is very often a lapse toward warmth cold medicines are desirable in order to preserve the natural complexion and the cold as it becomes tempered either removes the heat or makes it hotter and more gentle according to the measured quality of time.

That a warm abscess is caused by cold is the witness of Rhazes, *Continens* XV, on the authority of Paul of Aegina, who says a warm abscess occurs in the thick membrane (*dura mater*) either from a sharp bone that is puncturing or from the weight of bandages and ligatures which afflict it with cold or because the patient's regimen is not reduced whence nourishment abounds and because the patient drinks a superabundance of wine.

Haly holds the same opinion in *Theorice* IX, chapter 85. He says an abscess occurs in this covering (the *dura mater*) because of a splinter of bone which punctures it, from the force of the bandages and their constriction, from soap wort applied to the wound, from too much food, cold, or heat. The prince (Avicenna) has mentioned all these details in the chapter referred to and says that a warm abscess does not occur in the membrane except on account of a bone protruding under it, the weight of tents, cold, overeating, drinking, or some other hidden cause. He understands the hidden cause to be an intrinsic humoral one such as repletion or perhaps a bodily cause such as a bad complexion or perhaps both of these.

Although it may be said that cold is the cause of an abscess we should not therefore use something very hot because undue heat brings on a hot abscess according to Haly, above. Let the air be tepid inclining toward hot, as Rhazes says above on the authority of Paul of Aegina when he says a cure is made more swift in a warm place where the membrane of the brain is not chilled.

The warmth of the air not only causes an abscess of the membranes and of the brain but also ephemeral and putrid fevers which cause the humors to become ebullient, bringing on burning heat and weakness of powers. Considering this, Avicenna, *Canon* I, fen 2, chapter 1, p. 36r, says the hot air dissolves and relaxes. Hence in *De Ingenio Sanitatis* III (*Methodus Medendi*, Vol. X K.) Galen says that the air which surrounds a patient must be considered since it affects the body as a medicine does. We must therefore expose head wounds to an air which is not cold lest the aforesaid results occur not to an air that is very hot, taking into consideration at all times the seasons, complexion, age, region, and other similar factors. If fever and a hot abscess occur and similar ills we must use contraries against contraries since every cure is effected by such a method. We often require a temperate air so that the complexion may be maintained in balance.

If the complexion is out of balance the air should be such as to counteract this inequality. Hence Avicenna, Canon I, fen 2 chapter 4, p. 19 r, says on the judgment of the seasons that a season contrary to the complexion of the patient is suitable for him. According to Galen, above, in his commentary on X and XI, when the patient is distemperate he should be brought into balance by reducing the excess of the bad mixture of humors. He should not shiver with cold nor sweat in the heat.

Note, reader, that although Galen's opinion has to do with the preservation of health it can also be applied to the removal of illness for as similar administrations in the proper manner conserve that which is similar to them so contraries are effective for removing contraries. Whether they do so formally or effectively Hugo [Ugo Benzi of Siena, *Trattato ... della sanitade*, 1481] determines best in I, 4, of his book, although Galen in the foregoing passage uses the example of tempering the air according to the changed mixture of humors in the body he understands the remark to apply as well to the other six non-naturals as Haly Rodoan explains it although the Plusquam Commentator understands it otherwise.

But since we cannot preserve the aforesaid opinion or rule on wounds of the head nor in wounds of the nervous members nor in cold members such a statement is to be regarded with caution because if he postulates that a wound in the head may be accompanied with fever or not we ought not to employ one and the same air because when fever is occurring we decline somewhat from the heat of the air, but without fever we are in a somewhat different state of being. But we never allow cold air such as is done in fevers without a head wound.

Note, however, that the fever is in force during a season when the head is well covered. An air which is milder should be sought in a warm season in which the bare uncovered head is medicated. This is the proper treatment by skilled physicians. Therefore I praise, as I said elsewhere, the surgeons who call in a practiced physician so that an irremediable error may not be made for reasons discussed above when there is no fever.

But when cold air is feared expert surgeons always cover the head with some light warm cap made from lamb skin or skin of some other animal or a woolen cap or one made of cotton in many pieces so that the head may remain mildly warm. If the patient complains of too much heat or too little if he is in a state of reason let his attendants add or subtract warmth according to his desire. But if the patient as often happens is incompetent to judge his own condition or needs in the matter of covering let the physician decide according to the weather, season, and region for the air will vary in temperature.

Since the region also varies not a little as to the cure because some regions have warmer air while others have colder air or heavier or lighter, as the case may be, these facts must be carefully taken into consideration.

Aristotle, *Meteorology* I, says the air is three-fold. The lower part is hot and humid not only essentially but accidentally. The air is humid accidentally on account of aqueous vapors mixed with it. It is also humid by nature and warm, but it is also rendered warm by accident because of vapors and exhalations coming to its lower region from the water and the earth which participate in a certain warmth by reason of the agent by which they are produced, the heavens. Such a region is also warm because of the rays of the sun reflected from the earth and water which generate warmth. The upper region is warm and dry, warm both by itself and by accident, but it is dry by accident alone and it is rendered such by its proximity to the element of fire and from its closeness to the sky by whose motion it is led around and in it the warmth is increased. Such a region is uninhabitable.

The middle region is cold and humid partly due to lack of the causes which make other regions warm. The sun's rays do not reach it reflected from earth and water, but there begins the second region where the reflected rays end and there the first region ends. This second region is also quite remote from the element of fire and thus is not warmed by it. It is also remote from the sky because it is not moved circularly in following the daily movement as is the upper region.

The cold is increased by aqueous vapors which contribute their own cold to it and by *antiperistasis* [cf. Aristotle, *Meteorology* 348b2] the cold shuns the warmth of the upper and lower regions as its contrary. Thus the middle region is always cold and humid but the lower region is not always warm because it is rendered cold in winter and at other seasons. It is also made cold sometimes by the mediation of the sky, sometimes by rain, snow, hail, frost, ice, winds, and the lack of the sun's rays by reason of clouds or night time. Nevertheless, there is some warmth in this lower region, more or less, according to the reasons given above. Seneca, however, in his *Natural Questions* has other views on the qualities of the air in opposition to those of Aristotle.

Having examined the quality of air, let us come to the regions. I say the major part of the habitable world is near the lower region of air. This region stretches near to the base of the mountains or a little higher. The middle region is habitable, mountainous, high, and sufficiently elevated as are the mountains of Italy and similar altitudes. The other region, that is, the third, is above this one and summits of some of the highest mountains reach it. To this elevation, according to Aristotle, *Problems* 26. 944b13-21; [cf. 25. 939b1-4; 940b35-38; *Meteorology* 348b2] the winds do not ascend, and Albertus Magnus on the winds says the sign of this is since the ancients at a certain time in the past sacrificed on the tops of mountains they found in the following year the ashes of their fires in the same position in which they had left them. This would not have occurred if the winds had ascended to that place of sacrifice.

All the places in the middle region of air are cold and consequently dangerous to head wounds. Hence the cure must be changed as far as the regimen of air is concerned in such a region. Such places in Italy according to some people are Perugia, Florence, and almost all of Tuscany and Etruria and elsewhere in mountainous locations similar to these.

Nevertheless, I believe such places also are in the first region of air because since they are near to the middle region they partake also of its qualities. Hence Averroes, commenting on Aristotle, *Meteorology* I, says that in the high mountains there are cold and humidity because of their propinquity to a cold place, and so I think the aforesaid places are cold for the same reason. They also say that some places are bad for head wounds because of the thinness of the air in those places. They say the winds thin out the air by resolving and destroying the vapors which arise from the water and thus thinness mixed with cold is harmful because such air more easily penetrates what is thick and thus more quickly intensifies the cold.

They also say that the air is cooled by the quality of the winds. This happens at Bologna, which is not mountainous although it lies near mountains nor is its territory low and depressed. Nonetheless, it has a thin and cold air not because it is in the middle region of air but because the north wind makes it cold and thin. Through its reverberation in the mountains the air near Bologna is made cold and thin. Hence fractured heads in that city are preserved with difficulty from such a quality of air. There are some flat places also close to the mountains in which the air is warmed by a south wind in addition to vapors arising from earth and water. Such places are Rome, Pisa, and localities placed under the south wind. As Maffeo De Laude tells us a certain physician who was wounded in the head caused himself to be transferred from Florence to Rome and there he was cured. At Florence the air is certainly thin and cold because it lies in the mountains where the winds thin the air and it is cold for the aforesaid reasons. Nonetheless, the south winds blow there sometimes and warm the air. North winds are not very strong there except when they blow from very high upon the Apennines and bring in the cold. Nevertheless, comparing the air of Florence to that of Bologna I say it is colder at Bologna. The proof of this is that fruits ripen much more quickly and all seeds and vegetables are available sooner at Florence than at Bologna, but some say this is because Florence is closer to the equator and the sun's warmth comes sooner to that region. Thus fruits and other products mature more quickly there.

But there are some places in the middle region in which the air is moderate unless by accident it is warmed or cooled as at Rome and Bologna, in which the air should be temperate because they lie between the lower and middle regions.

Hot places are low and full of valleys such as Ferrara, Venice, Ravenna, and similar localities in which the air must be warm unless changed by some accident among those discussed and to be discussed. This same comparison of the air can be made in regard to each place equal to other places in whatever region. The farther south any region lies the warmer it is, the farther north the colder it is. Hence the air in Germany is heavier than the air in Italy because the effect of cold on air is to make it heavier. Thus those who are wounded in the head die more rarely in Germany than in Italy although this may be due also to the robust strength of the patient. Galen, *De Ingenio Sanitatis* X, 4, says a strong constitution resists everything but a weak constitution succumbs. Let physicians therefore be careful in considering the region involved in a case and temper the air for their patients because it is not my function to describe places here in detail. Let it be said that flat low-lying places are warm and those which are high and mountainous are cold unless their quality is changed by the winds as mentioned above and the middle region is between these two. Some say that all rocky places are very cold and in a cold season and very hot in a hot season on account of a dense terrain. Consider what it may be for you since this is easily solved.

Nevertheless, some places can be cold and hot by the nature of the particular location such as hot springs and mines which affect the air around them with their special quality. Some baths or springs have iron or copper, niter, sulphur, alum, and other materials in their water which exist in nature and thus are altered by these substances. Perhaps also the heavens in some spot by the mediation of a fixed star influence some quality there which is not included in the aforesaid causes.

Joannitius [*Isagogae: circa* 809-873 A.D.; cf. Temkin, *Galenism* ..., 106] is witness that the air is changed according to the aforesaid causes. He says there are five modes of change of air: at the change of the seasons, the rising and setting of stars, the blowing of winds, the location of the earth involved, and vaporous accumulations.

The complexion of the air is also changed by the seasons of the year. The air of springtime is regarded by Galen and his followers to be of temperate complexion. Aristotle and many philosophers regard it as hot and humid, the air of summer hot and dry, of autumn cold and dry, and of winter as cold and humid. The complexion of the air changes at certain times of the day due to the power of the sun. Hence Haly, *Theorica* V, chapter 3, at the end, says it must be understood that there is a certain proportional similarity between the time of day and the season of the year, for springtime is similar to the beginning of the day, that is, the morning; summer to midday and its confines; autumn finally similar to evening and winter to night.

One must depend upon familiarity with the place chosen for the patient's use. Let the physician in regard to the patient's needs keep him when in cold places where the rooms are warm, well- closed, and small because where there is less air it is warmer, according to Aristotle, *Problems* 25, 18. Narrow spaces are warmer either because much movement of air makes a place cold or because motion of air cools off hot things. This particular answer of Aristotle to the question confirms the reasons given by me above as to why the air at Florence and Bologna is cold. This is because the air moved by the winds is given the quality of the wind, that is, cold.

Here we must consider Aristotle's view of the question because he says that motion causes frigidity in a place. Elsewhere he says motion causes heat, but since this question is clarified in physical science we must return to it lest surgeons be afflicted with tedium, for I have said much against their proposals which are the result more of sheer laziness than of what pertains to surgery.

Such rooms in whatever region should be chosen in the lowest, depressed place rather than in a high place exposed to winds and much motion of air where cold is created, according to Aristotle. In *Problems* 25, 21, he explains why in lofty houses the air is constantly ebbing and flowing.

In the cold weather the rooms should be kept warm with a fire but not from a charcoal brazier, says Niccolò. I say such a fire ought to be made with sweet, dry, well-seasoned wood from which no bad fumes arise, because I have seen many charcoal fires in closed spaces which brought on stupor, serious accidents, and sometimes death. Always keep some iron grate or glass over the wood fire embers so that the bad vapor should be avoided and everything which produces sneezing.

At the time when the patient is being treated some portion of the fire should be near the injured member. Among other things four or five large candles should be lit and placed around the patient's head so that with their light the physician may perhaps be able to see something hidden such as hairs or bloody pus or a capillary fissure or such things. In addition, the candles can warm the air.

Among other things I use in the process of treating the patient when I have detected the existing wound are three or four white linen bandages of moderate size warmed and placed alternately upon the head while the wound is being cleansed by hand and medicated because their warmth greatly aids the patient and preserves his natural body heat.

This warmth is conditioned by his complexion, age, region, and similar factors such as fever, abscess, and other customary symptoms. When their cause is considered perhaps heat would increase the aforesaid concomitants. Not only should the air be conditioned in its warmth as was said but it must also be free from every evil smell and vapor because it could be the cause of death. Avicenna, *Canon* I, fen 2, chapter 5, says air is of good substance in which there is no extraneous admixture of vapors or fumes; it ought to be of good odor and sweet although some say that perfumes should fill the head.

I believe in universal facts and that when the body is well cleaned and the suspicion of an abscess has been disposed of that temperate aromatics are helpful in the cure of head wounds and that at whatever season there is a weakness of force caused by the resolution of the spirits we then require a restoration of them.

It is a precept of Hippocrates and Galen that when we desire to bring aid to a body's forces as quickly as possible it should be aided with some good, light, and abundant nourishment as Avicenna recommends in *Canon* I, 4, on providing food, including wine, water, meat, and sucking eggs. When we wish to do this more quickly for the patient we should provide odorous substances so that the spirits may be restored and generated speedily from the air. Air of good odor nourishes more than pure air, whence Avicenna on heart medicines says that of two equal medicines the sweeter, that is, better in its force is aromatic. Where he speaks of how to aid those who suffer from syncope he says good smells nourish the spirit except in syncope caused by suffocation of the uterus (*angone*, uterine strangulation) because the attractive force of the members receives the smell more readily and the spirit is more swiftly nourished if it has the power of nourishing and it suffers because of it insofar as it is medicine.

Among other odors I like rose water with cloves, wood aloe, roses, sandal, and a little ambergris set aflame when sprinkled on a sheet of iron and lightly burned in a closed room or boiled in water. These aromatics and many others are given by physicians and are determined as the individual disposition requires, now cold, now hot, now mixed as the expert physician decides while the air tends to be dry, for all wounds and ulcers insofar as they are such require a certain drying out especially in the head since in ulcers and wounds made by contusion we use substances which mollify and putrefy and to proceed in such a way in the head is dangerous. One should therefore proceed carefully with drying substances for the air tends to dry out head wounds.

Among all things I recommend that into the room should be placed a large number of freshly baked loaves of bread because they warm the air and provide comfort as is told in the story about Democritus, who lived for a certain number of days solely on the smell of fresh baked bread [Diogenes Laertius, IX. 43; Cael. Aurel., *Acut. Morb.* II, 37]. That odors nourish is confirmed by the fact that everything mixed is adapted for nourishment except when mixed with poison, especially corrosive and putrefactive such as sublimate of arsenic and many other poisons, omitting the story of the girl nourished on poison. These words I wish to be sufficient concerning air, and I place all of them into the hands of a prudent and legitimate physician.

Regimen of Motion and Rest

Let the patients be prudent concerning motion and rest. Movement disturbs and fatigues bodies which are weak and stirs the humors, which can easily run to the affected area and cause an abscess and other bad phenomena. Niccolò, author of the compendium, [Nicola Falcuzzi or Niccolò da Firenze; died *circa* 1412; author of *Sermones Medicinales*, a large compendium of medicine], says the patient should be advised to remain quiet nor to turn himself frequently from side to side nor to hurl himself from place to place but to lie on the side of the injury because the wound will purge itself better in this way unless something prevents it.

Let him above all beware of moving his head and the upper members of his body because motion attracts pus to the head while the motion and massage of the lower members divert the pus from the head. I always use massage and cupping of the buttocks in order to assure an abscess without scarification.

Regimen of Food and Drink

I thought I should pass to the discussion of food and drink which can be more strictly called a diet. The wounded patients ought to be fed and given drink according to the nature of the wound, his strength, and symptoms. Care should be exercised as to his age, habits, complexion, the season of the year, the time of his illness, the region, and such like.

Beginning with the nature of the lesion I say that in whatever lesion of the head discussed and to be discussed the diet should be thin in quantity and quality so as not to produce expletory abscess, fevers, and other ills which are accustomed to occur in such cases because if nature is not occupied in digesting food it will regulate the other superfluities if there are any since although breakage of continuity is an illness without pus it is however often combined with pus. Thus the patient will avoid and escape shipwreck.

Since lesions are of different kinds the diet must always be varied to accompany large, small, medium, very small, and larger wounds, tending toward thinness until the physician may judge the patient to be safe from complications. As I said before I dare not hold the reins loosely on my patients while the signs are good until that critical twentieth and twenty-first day has passed. I have often and for a long time observed portents which appear around those days. If I concede something to my patients I do so with reluctance and dubious prognostication; those who follow this practice deserve nothing but praise.

Physicians should remember Galen's golden word on *Aphorisms* I concerning that critical time which is to be feared, for the physician is not a carpenter but works with the human body; he does not work with stone or leather. If we work with these substances no corruption results if the artifacts we make are not successful. But if this imperfect handling occurs in a human being the individual is destroyed and cannot ever be restored. He (Hippocrates) also said that judgment is difficult. I infer from this statement that the physician should direct the diet of his patient in such a way that he may seem to have good judgment and so that his patient should not die from over-eating. I never saw one die from famine and hunger. Therefore let the physician keep the wand with its coiled serpent in his hand, that is, the scepter and true dominion over those who are ill with prudence. Then he will not err and will save himself and others.

Among all things the strength which requires conservation must be considered since without strength no judgments can avail. If the patient is strong no further diet is needed for him more than his disposition requires. Whatever disposition it is with cranial lesion it is to be feared because of what has been said on the subject, all the more if the lesion is within the cranium. The diet will then be thinned by avoiding wine, meat, and all hot foods because according to Paul of Aegina, Haly, and Avicenna much food and wine cause a warm abscess. Thus let the twenty days pass with a thin diet on account of what has been said above.

The physician should above all remember Avicenna's advice on the feeding of fever patients (*Canon* IV, fen 1, tractate 1, pp. 393-399). Such lesions without fever are rare and *Canon* III, fen 1, discusses food and drink and any regular diet. Patients should eat a small quantity of food, of little nourishment and easy to digest so that they do not have evaporations to the head. They should have few superfluities and be free of cooling and humidifying vapors and those which reduce extraneous heat.

Paul of Aegina, Haly, and Avicenna corroborate the statement of Ais. Abulcasis. He says beware of repletion, wine, and heavy foods. There are those in our day, however, who during the entire process of the cure allow wine for those wounded not only in the head but in the chest and in all the members both nervous and fleshy. All people should shun this group of practitioners as they would abhor and flee from a witch or a poisoner, and if indeed some patients are cured by this kind of carelessness it must be said as Avicenna says of Rhazes that the method of those who led by error still cure patients is not on this account to be followed. I find no reason or authority to make me yield in this matter except in one case. When the patient is weak especially in the way of resolution the swiftest penetration will be achieved by the use of wine, according to Avicenna, *Canon* IV, fen 1, chapter 1, as well as Galen on *Aphorism* II, 18: "Of foods which nourish either immediately or soon wine is one we use when we intend to stimulate the body's strength." Avicenna in the same chapter says it is a necessary swiftly penetrating nutrient when we wish to reinforce physical strength while the stomach and its powers cannot tolerate as nourishment that which is digested slowly.

This resolution of force is caused by the quality of the wound because it is perhaps a painful evacuation and extinction of the spirits or it is caused by a flow of superfluous blood in which the soul exists, whence the poet sang that

He poured out his life with red vomit,
And mixed with his blood as he died was the wine he had drunk.
Vergil, *Aeneid* 9.349- 350

But when strength is restored with wine abstinence should immediately be exercised because wine is very inimical to wounds and no rational physician thinks otherwise. The very learned Celsus, *De Medicina* 5, 25, on the diet used in the cure of wounds says: "Many who are actually fainting from loss of blood must, before any treatment, be resuscitated by wine, which in other cases is most inimical to a wound."

The moderns more boldly use some good soup either of capon, pheasant, or chicken, with water of flesh with pearls and four cordial flowers (borage, bugloss, roses, violets), with fragments of gems and *manus Christi perlata* [hand of Christ laid on, i.e., troches prepared of pearls and sugar of roses] or other suitable remedies to restore strength.

If wine is given it should be diluted with water and a crumb of bread added which stirs the vaporous parts. In this I defer to experienced natural scientists.

I do not recommend wine except under the limitation aforesaid and only so far as it restores the loss of physical force because wine evaporates to the head suddenly and harms it, according to Avicenna, *Canon* I, fen 3, chapter 8, p. 60v, on water and wine. Haly, *Theorica* V, says wine harms the brain and nerves. Many others think the same. It is also not suitable for fevers. Rare are wounds of the head which penetrate to the interior which are not accompanied by fever. Therefore the use of wine should be avoided by those who are wounded in the head. Until the abscess has formed the diet described above should be followed and food gradually increased in quality and quantity until the twentieth day is past.

In the first days all meat and sucking eggs should be avoided as well as milk, fish, wine, and all seeds of fruits because they fill the head and everything else that can be included in the aforesaid. It is said in [Rhazes] *Continens* I that Oribasius said things which produce headache are the blackberry of Celsus, strawberry, paradise apples, pine nuts, large dates, cole wort, wood crocus, parsley, onion, aromatic wine, and grapes preserved in grape must.

The diet recommended by Niccolò is a crumb of bread washed, a kist (14 grains) of barley, spelt, oats, soft vegetables such as spinach, *atriplex sativa* (goose foot, stinkweed), blithe, lettuce (although it is not approved by all because it fills up the head). I have, however, used it in such cases, and it was very helpful. Other foods are gourds and for the second course cooked apples, pears, quince, pomegranates, oranges, and such like. But if constipation sets in let the patients take two or three fresh dry plums with sugar or without it as they wish at the beginning of the meal.

If for some reason meat is obliged to be eaten by the patient he should eat young healthy birds, chicken pullets, pheasant, or partridge, well reduced to a soft pulp. The meat should be pounded and eaten with a little broth and garlic and similar food. A drink of barley water without the cooked barley plus sugar and pomegranate wine, barberry juice, julep of roses or violets, quince marmalade, jelly marinade made with quince or pomegranate, that is, the juice of pomegranates made into a jelly with sugar, and similar foods are suitable for those with head wounds.

Avicenna, *Canon* IV, fen 4, tractate 1, chapter 12, p. 448r, on the cure of head wounds says one should feed patients with roasted chicken brains as much as possible since some people declare that they comfort the brain and check the flow of blood although others have a different opinion and say that pomegranate water is helpful, that is, a wine made of pomegranates muzi. To stop a flow of blood there are other methods according to Dino and Niccolò, who differ on the question. See each of them, although their difference is slight.

Rhazes, *Continens* XV, chapter 3, at the end, on the authority of Oribasius, says that chicken brains given in a drink are helpful. In the same chapter toward the middle on the authority of Paul of Aegina he says in the *Memorial*, that is, the book so named, if a percussion has taken place on the head and blood is emitted from the brain chicken necks in a drink, that is, chicken brains roasted for the entire meal can be given frequently as well as pomegranate wine.

There are many moderns who when the danger of abscess has passed and the concomitants which have been mentioned earlier use a heavy, viscous diet so that the scab on the wound will be formed sooner and become harder. Such foods are the feet and extremities of the calf, goat, lamb, the cooked intestines of these animals, cooked wheat, and such foods.

But since among all the branches of medicine [i.e., diet, medicaments, surgery] this one called diet is required on the testimony of that very illustrious author Celsus, he says at the beginning of his book (*De Medicina* I, proem 9): "That part which cures diseases by diet those who were by far the most famous authorities, endeavoring to go more deeply into things, claimed for themselves also a knowledge of nature, without which it seemed that the art of medicine would be stunted and weak" (Loeb Classical Library translation). I ask the practitioners of this art that they should call in a dependable, experienced natural philosopher or physician as I have frequently said to whom they can turn over their gainful labor in dieting and administering drugs and all the other purposes of medical care and should communicate in order to be of one mind and in harmony for the sake of their patients' health. Let this suffice on the subject of nourishment for the patient.

Regimen of Sleep and Waking

As to sleep and waking patients should be careful for Rhazes, *Continens* I, says it is said in Aristotle, *Problems*, that long periods of wakefulness induce headache because they impede digestion and cause hot vapors to ascend to the head. Long sleep similarly causes headache because it extends digestion and fills the head with humidity. Niccolò says patients should avoid daytime sleep unless it is their custom or unless they sleep and rest badly at night. They should not go to sleep until at least two hours after their meals in order not to fill the head with vapors from food.

Note that because there is often doubt in the diagnosis of head wounds about coma unless the situation is clear the patients should not be allowed to go to sleep quite deeply unless the body is very clean because either it has few superfluities or has been cleansed by medical means since at this time the greater part of the body is full of many bad humors. Therefore let the physician be prudent in this matter. But if the body is clean I say that sleep is beneficial as long as it is not too long for sleep digests and resolves superfluities and strengthens the inner heat. This expels the bloody pus and other harmful substances, the sign of which is that always comparing all wounds, night to day, and sleep to waking they emit a greater quantity and a better quality of bloody pus at night and in sleep than when the patients are awake during the day.

If the physician should see the beginning of coma he should by no means allow the patient to sleep unless his sleep is the result of overdrinking. By the use of tight bandages, plucking of hair, shouts, and other appropriate remedies against coma the patient should be kept awake because if he falls asleep deeply his head will be filled up, abscesses will form, and suffocation will follow. I leave the care of coma to the prudent physician.

Regimen of Inanition and Repletion

Under the heading of evacuations or elimination and constipation are bathing, coitus, urine, sweat, defecation, and blowing and wiping the nose and similar evacuations. Of these let us say and we do say that bathing is useful in cases of head wounds very often for the sake of diversion. Pure warm water applied with stinging effect to the extremities diverts humors from the head, and if the patient suffers from an all night revelry and too much wakefulness, the warm water induces sleep by diverting and evacuating some vapors from the body which are caused by wakefulness.

A decoction should be made in pure water from white poppy hulls, violets, camomile, ivy leaves, and fronds of cassia. This mixture when applied in the form of a bath to the extremities brings sleep and helps to resolve abscesses of the brain. When practitioners in general intend to achieve the resolution of an abscess or of other pus in the head which causes doubt as to the possibility of an abscess they prepare a bath, adding and subtracting whatever is to their purpose such as the lung of a ram or a lamb which they boil together, making an embrocation or fomentation for the head with it or with sponges or something else. In this way we say a bath is beneficial for wounds of the head although perhaps such things also pertain to the making of a potion. Such matters as these are inserted here in order to complete the discussion of bathing, although the lungs are rarely used.

On Coitus

Although coitus, that is, the emission of sperm, pertains rather to the subject of potion rather than to that of regimen since sperm is properly not a superfluity such as sweat, urine, feces, and such like and is a secondary useful superfluity like phlegm (being of prime alimentary value useful as such but secondary when it is called sperm) we can say it is useful as the ultimate form of nourishment.

Nevertheless, to proceed in the order in which Haly treats these subjects, a discussion of sperm or of coitus should be inserted here. Let physicians apply their utmost diligence to this subject so that no error may be made in regard to it since no one is so prudent and restrained that when opportunity is offered he would obey the mandates of medicine in regard to coitus.

I say that coitus is very harmful in cases of head lesion because among other members it injures the brain, nerves, and eyes according to Hippocrates. The sperm comes from the veins around the ears by the mediation of the brain. Nevertheless, some hold an opposite view and this will be discussed elsewhere (see *Isagogae Breves*, trans., p. 107).

Coitus makes the humors ebullient and sets them into motion, crushes, suffocates, and weakens bodily force, is harmful to the stomach and its connection with the head, renders the entire body cold, weak, and bloodless. Thus Avicenna, *Canon* III, fen 20, tractate 1, p. 352v, says coitus evacuates from the last food eaten and thus brings on a weakness unlike that made by other evacuations. It also evacuates or empties a very large part from the substance of the spirit on account of its great delight. Hence the more one takes pleasure in it the more one falls into weakness. He also says that coitus resolves or diminishes the innate heat and destroys bodily power if it is superfluous, weakens hearing and vision, causes tremor and pain in the legs, and induces acute fevers, tremor, debility of the nerves, wakefulness, epilepsy, pain in the kidneys, back, and bladder, and colic.

Nevertheless, in some cases coitus is allowed. On this see the Conciliator, among others, *Differentiae* 186 and 129, who lists all its advantages and disadvantages. Nonetheless, I say that coitus is very harmful in cases of head lesion because the humors are agitated and set in motion toward the upper part of the body and can cause abscess.

Considering Aristotle, *Problems* IV, 1, he asks why a man when indulging in sexual intercourse and when dying turns his eyes upward but when asleep downward? Is it because when the heat is emerging upward the eyes turn in the direction in which the heat travels?

Coitus also is harmful because it weakens the strength which is not good for any illness in its cure. Therefore in *Problem* 6 he asked why is a man more slack after sexual intercourse than other animals? The same opinion appears at *Problem* 21: why do those who indulge in sexual intercourse usually become slack and weak? Although it may be said by some that coitus makes one cold this is not true. It heats the entire body and injures the head with its heat for reasons often stated. It make the body cold, however, after the act, especially if the body contains superfluities.

Let physicians therefore be prudent in resisting the enticements to coitus by guarding their patients well both day and night against such an act, and let this be said about coitus.

Concerning Superfluities of the First and Second Digestion

Let the physician endeavor with all his might also to extract the superfluities of the first and second digestions from the patient's body if nature does not do so by itself. Let him administer a lenitive clyster at least once a day for the elimination of the feces or a suppository of honey or lard, a radish root, a leaf of cabbage, or something similar. Let him provoke the urine if he can by stimulating the patient with words so that he empties his bladder himself. Sometimes the patients cannot urinate because those parts of their body are softened or in spasm or because they themselves are comatose and drowsy and thus do not remember to urinate. The physician cannot so easily remedy the retention of urine as he can overcome constipation on account of well-known causes. Therefore the pubic area should be massaged by an experienced physician and treated with fomentations made with comforting, softening, and resolving substances in order to achieve the desired result.

Oil of scorpions is valuable for this purpose when applied around the pubic area together with a fomentation made of wall pellitory, butter, and the aforesaid oil. Or something should be placed on the tip of the patient's penis such as a flea to stimulate urination. Finally, let the physician consult the treatises which deal with the difficulty of emission of urine.

On Sputum and Mucous Discharges from the Nostrils

It is also helpful for the patient to void the superfluity of sputum as much as possible because it is a burden to the head; he should also purge his nostrils of their mucous discharge. This should be done gently at first until the abscess is formed. If some bone, however, is puncturing and burdening the membrane nothing should be done with the blowing of the nose except to use it for breathing. All patients are allowed to do this, but if the patient in question grows worse I recommend a stronger blowing of the nose but not too strong lest some little veins in the head should be opened. A moderate blowing expels the bloody pus from beneath the bone if there is any. Let this be done while the patient is being medicated so that the physician may ascertain if blowing the nose is helpful or harmful.

On Superfluity from the Eyes and Ears

Since superfluities from the eyes and ears are not subject to voluntary action I cut short the discussion of this topic. Nonetheless, I say that if by chance nature should try to expel something harmful through the ears such as bloody pus or wateriness the physician should assist by wiping and washing with the appropriate means and by applying medicines which draw out such substances.

On Sweat

Since nature often either in a crisis or by symptom expels sweat I say nature should not be impeded when a plethora exists, but I also say that sweat often issues from a place which is hot. Then the physician must ascertain whether this is due to bodily strength or to an illness, whether the body is full or not, strong or weak, and to minister to the sweat or to its cause.

On Vomiting

With all one's efforts one must be on guard against vomiting because it is contrary to the *Aphorism* (VII, 10 ?) "which should be removed, etc." This certainly is not suitable even if the region is one where the custom is to vomit on certain days, as many do. Let the patient abstain from vomiting until he is cured.

On the Extraction of Milk

Since lesions of the head often happen to women who are nursing babies let us say something here for their sake. I say a woman ought not to give suck or be milked in any way until the abscess has formed because this extraction of milk evacuates the mammillary veins, and the veins which nourish the breasts should not be emptied. Blood flows from elsewhere into them and although veins ascend through the abdomen to the breasts bringing blood to them from the uterus by which the milk is made nevertheless also from upper veins around the upper ribs of the chest there come veins for the purpose of concocting the blood and converting it into milk. Since this blood is by far hotter than the blood in the lower area those veins should not be emptied. Both upper and lower veins which draw blood to themselves from neighboring veins should not be emptied because then they put the humors into motion. They do this because the upper veins are close to the guidez and the deep veins. These are called apoplectic or veins of sleep [jugular, carotid, apoplectic]. They can fill the head and put the blood of the head into motion because the guidez and apoplectic veins are those from which all the veins of the head originate. Therefore women should refrain until the abscess has formed from any extraction of milk from their breasts.

It is true that when evacuation by phlebotomy and by emptying the stomach has been carried out as needed that the extraction of milk can be accomplished more safely. Nonetheless, the humors may still be put in motion by such an extraction. It is more prudent to wait until the twenty days have passed, at least the fourteenth, before extraction takes place. Let evacuations be made in some other way than with milk. This is enough on the subject of inanition and repletion.

Regimen of the Emotions

We must now come to the final item of the six non-naturals, the human emotions. Niccolò says the patient should be advised to avoid anger and hate no less than fear, sadness, and fury and to drive out completely from himself every worry because these emotions set the humors in motion and cause bad accidents or concomitants. Rather, he should rejoice as much as he can and be happy; let him seek gaiety, every kind of delight and joy of spirit, but he should shun, however, jokes, song, and everything adapted for setting the humors into motion.

Let the patient's abode be closed and dark so that his mind is not disturbed by the light, and let him avoid speaking because talking is the greatest of the forces which draw pus to the head, as Avicenna says in *Canon* IV, fen 3, on the cure of scrofula, but let his speech be restrained and infrequent.

Let him avoid all noise and rumbling because these also stir the humors into movement, and all frightening experiences because they sadden the mind according to Aristotle, *Problems* VI, 7, where he asks why it is that when we see anyone cut or burned or tortured or suffering from any other cause, we also suffer in mind.

Let the attendants of the patient avoid speaking of anything contained in the aforesaid problem. Let them avoid anything which causes a harsh sound because it is frightening and the humors are agitated by it. The feelings are stirred not only by sight but by sound, according to *Problems* VII, 5, where Aristotle asks why do some things unpleasant to hear make us shudder, such as the sharpening of a saw, the cutting of pumice stone, and the grinding of stone. Let the attendants of the patient beware of what has been described because sick people are injured not only by seeing but by hearing such things.

Among other considerations the patients should have confidence in their physician because many times it is confidence which cures them, the Commentator says. The man in whom the patient has confidence is able to discover the nature of his illness and is the reason why the patient commits himself the more readily into the physician's hands. The more he does so the more the physician can cure illnesses. Hence Galen said that in which one has confidence heals the more. Avicenna says an action dependent on confidence will be more effective than whatever a physician does with his medicines. He also says there are some souls which not only accomplish very great and marvellous operations on their own body but also on another body without any intervening aid. Such is the work of the enchanter's eye. But some say this confidence depends upon a strong imagination which is moved from heaven for not every imagination is effective but that which is moved by heaven and then the cause of the cause will be the cause of the caused, as Albertus Magnus says in his book on minerals [Albertus Magnus, *De Mineralibus*, Opera Omnia, Paris, 1890-1899] where he seeks the causes of images in stone.

Whatever it is, I believe that the patient's confidence is helpful in the cure of illness. I notice that it has often happened to me that while visiting the sick I have made absolutely no change from the remedies prescribed by others although I pretend to change them and immediately the patient's case took a turn for the better. I have seen the same thing occur to many other physicians. Hence the Conciliator says that not rarely do we see a patient's health grow better on account of the hope inspired in him by a famous physician and one who has been sought after to such a degree that it seemed the very sight of him did more good than his actual medical services.

Nevertheless, he means that confidence brings assistance in various ways in a given case. He postulates many differentiae on the matter notwithstanding. Among others, he points to the favorable intellectual understanding or imagination or whatever inner power of feeling the form of confidence may be understood to be in comparison to whatever benefit there accrues from what is actually done externally to the patient by the physician. He says that confidence based upon intellect provides less help toward better health than that confidence based in imagination and still less strongly than in anything external because that is more impressive which is comprehended by a particular sense.

Let us say therefore that confidence is a valuable aid especially when we see it daily in that faith in Christ which heals so many. Hence the apostle said: "Thy faith hath made thee whole" [Matthew 9.22].

The fact that the confidence of the patient is an aid to his better health is shown because the body is affected by the soul. Aristotle, *Physiognomics* 808b12, says the body suffers sympathetically with affections of the soul for souls are affected by bodily movements and impressions as is apparent in illnesses (see also 805a5). Thus conversely the body is affected by the soul as, for example, in fear and happiness. Hence Galen, *On Clear Movements* [= *De motibus manifestis et obscuris*, a pseudo-Galenic treatise published by R. Charterius in his edition of Galen, Vol. V, p. 397, Paris, 1687; not in Kühn's edition] says that the change of the body imitates the change of the soul not only in movement but in the alteration of color. And so if prophecies will cure this is due solely to confidence. Therefore prophecy becomes a part of medicine when it is reduced to the human emotions, which are one of the six non-naturals. Thus I end the discussion of that branch of medicine, that is, diet as used in the care of head lesions and pass to the second branch, that is, potion or the use of medicines.

On the Cure of Skull Fractures Through Medicines

As was said above, the second instrument or branch of medicine, that is, drugs, is part of curative medicine which heals illnesses both internally and externally by simple drugs according to Galen, and here my purpose is to discuss it.

But since, according to Niccolò, there are three sects as to the method of cure for head lesions we must see which sect is the more to be approved and followed before we come to the description of the medicines themselves.

One sect is quite old. It is not rational but empirical and flourishes particularly among the Jews. I have known many of them. To this sect adhere also some of the later physicians, among them Hugh of Lucca, Theodoric of Bologna, and many others, as Niccolò says, and some not inconsiderable surgeons who claim to be able to cure any kind of skull fracture with lesion of the membranes and the brain, with a wound made by contusion or some other means, by the use of pigments and potions. The purpose of these is to wipe away, resolve, and dry out as well as to remove every kind of bloody pus which impedes health not only in the head but in the spiritual and natural members together with fistulae and all bad ulcers.

When I was quite young, just a boy [*circa* 1467] I saw a certain Jacopo the Jew, who was a close friend of my father. He cured Ercole, duke of Ferrara, of a very bad blow from a fire lock in the foot. Jacopo was given a great reward and high honor. He also healed the great lord Marco Pio, in charge of the armor, of a fistula in the back with a certain medicine. He also cured another man, Antonello the Neapolitan, commander of cavalry for Marco Pio, of a wound made by a musket ball in the back with a certain potion. This caused the ball to issue forth from the wound along with the medicine itself so that the edges of the wound were continually colored with the color of the medicine and smelled of it also.

This Jew used to make the medicine alone, shut up in a room, but since he believed that I was a member of Antonello's family he took me with him to the fields and meadows, and I saw all the herbs he collected as ingredients in his potion. I shrewdly learned the entire process of making it and made use of it while I was still a boy. Thus by fire and water I saw the method of this particular sect of physicians and the methods of other sects. I not only saw this Jew as he practiced medicine but many others of his race. Although the components of his potion varied he always placed a cabbage leaf upon the wound as part of the treatment.

These Jews say that the aforesaid mode of operation was first discovered in nature by their wise men and thus their numerous followers extol themselves by means of their chatter and their muddling. These men are not few in number for as I learned the greater share of the surgeons in Germany worthy of respect cure with these medicines wounds in all parts of the body nor by the distinguished leaders nor generally by the surgeons and physicians who are trained is any faith placed in such a procedure because it is absurd, horrid, and detestable. Certainly this sect should not be followed, according to the testimony of Guido. If indeed some patients are cured by this method this is not due to the potion administered but to a strong and robust constitution in the bodies of that region. As Damascenus says, many who use medicaments have believed that they have been helped by them when nature herself often accomplishes the cure. Thus this sect and all the members of the other empirical sect should be avoided like poisoners, especially when the empirics administer their medicines without regard for differences in complexion, age, season, and individual strength. Certainly these medicines are not to be totally rejected if they are administered by a legitimate physician who knows medicine and the conditions of the human body. Thus there may always be among the aforesaid empirics at least one skilled and expert physician who with his temperate inspiration may direct the ship into a port of safety.

The Second Sect

There is also the empirical sect which holds that lesions of the head (whether with breakage of the skin or not and which cannot be cured without opening the skin and elevating the bone) can be cured with simple and compound medicines applied on the exterior of the head. They say the power of these medicines or their special property is sufficient to draw out what has collected beneath the bone or to resolve, consume, and evaporate it, or to dry it out, and finally the bones if there are any in the wound which cannot be extracted in the ordinary way, and finally to consolidate and place a scab on the breakage of skin and bone. I shall produce favorable reasons why this can and should be done.

The first reason is that this medication can be carried out with more or less medicine as such alone, but we must use the medicines required even if we move the bone as part of the cure.

The second reason this method of using medicines alone should be used is that it obviates the fear and other menaces to the individual's strength beyond the medicines themselves. Hence we must use them because the operation of moving the bone causes horror, grief, and agitation in addition to the danger of possible puncture, rupture, or some compression on the membranes and consequent flow of blood. Such an operation exposes the membrane to the effects of warm or cold air or some other untoward influence which can hamper the cure. It will perhaps cause an abscess and other bad concomitants. Therefore it is safer to use unguents, plasters, and other medicines rather than to operate on the bone.

The third reason for the use of this mode of treatment is that it more easily removes whatever impedes and prohibits a cure. Such medicines as plastera and unguents remove dirt, virulence, all humidity, and also other hindrances to the cure. This statement is bolstered by authority and experience. The authority is Galen, *On Simple Medicines*, the complete work, and *De Ingenio Sanitatis* [or *Methodus Medendi*, Vol. X K.] and elsewhere and Avicenna, *Canon* IV, on ulcers, and in painted pictures. Experience also proves that day by day we cleanse and dry up such ill effects in wounds. We can soothe and comfort the member and remove the pus, etc. Therefore it is better to use medicines.

The fourth reason concerns those who intend to move the bone. They do not do so unless the bone fracture is large or small, as will appear below, but to add a new fracture to the existing one is bad. It is to add evil to evil, and the patient will not be healed in this way, all the opposite. Therefore it is better to use medicines rather than elevation, movement aside, or incision of the bone.

The fifth reason involves the use of strong medicines which dry out the pus which is ready to issue forth from other members than the head whose skin is not so thin as that of the head as is shown concerning such medicines in *Continens* XIII, chapter 4, with a medicine made of bismuth and water of gum arabic. There it is said that this unguent is adapted for drying out pus when it is ripe for issuing forth and being dissolved. Galen says he saw this done with marvellous skill as if by magic in abscesses and elsewhere. Rhazes says the same thing. I say that this medicament dissolves pus. The bismuth is triturated or ground up in the manner of collyrium, then diluted with water in which galbanum has been dissolved. This preparation is then placed on the wound since galbanum by itself dissolves pus, as Bulgeric said. Bismuth does the same. Many other remedies are used by Rhazes. Medicines must therefore be used and not an operation on the bone.

The sixth reason also involves strong medicines which draw out pus. Not only do they draw out pus but thorns, darts, and bones. The works of the authorities are full of such information, for example, Galen, *On the Natural Faculties*, I 14, says: "I myself have seen a thorn which was embedded in a young man's foot fail to come out when we exerted forcible extraction with our fingers, and yet come away painlessly and rapidly on the application of a medicament." Likewise, in *De Ingenio Sanitatis*, IV, 3, 11, 15, he says medicine attracts like a cupping glass. Niccolò says the same on Galen's authority. Galen in *De Compositione Medicamentorum* (Vols. XI-XII K.) puts together an unguent made of basilicum (citron basil) with warm emollients, opoponax, aristolochia, and euphorbia which is stronger than other unguents in drawing broken bones and gross humors to the surface.

Dioscorides places betonica in the form of a plaster on the wound to extract bits of bones from the head. Avicenna does the same in *Canon* V, chapter 11, on the plaster made by Andromachus. These act like a cupping glass to extract thorns and bones. Hence use medicines and not operation of the bone.

The seventh reason is that if there is bloody pus under the bone or if it has flowed from pores of the cranium or through a fissure and in whatever way has burdened and irritated the wound it is expelled much more by medicines aided by nature. Avicenna proves this in his chapter on those substances which issue forth (*Canon* IV, 3, chapter 20) and Galen, *De Mala Complexione Diversa*, chapter 4, and Rhazes, *Continens* XIII, chapter 4, whom I have quoted above, where he has spoken of prognostics. They say that nature expels pus through the passages in the brain, through the nose and nostrils, and the palate, chiefly in the anterior part of the head. Patients are saved in this way. It is clear that pus is expelled through solid members also, according to Galen, *De Interioribus* V, chapter 3, where he says: "But we clearly see in the fracture of a bone that the blood comes forth to the skin and stains a bandage. Hence it is not possible to deny that it can penetrate membranes since the skin is thicker than the membranes," as he said a little space above. In his comment on Hippocrates, *Aphorisms* VII, 54. whoever has phlegm between his diaphragm and stomach and has a strong constitution has no trouble expelling it even if the pus is thick and the passages are narrow. For we see that the pus of an abscess when nature expels it from some places also passes through bones and from this it is inferred that pus can be expelled through the cranium especially since it is thinner than the rest of the bones and nature is so much the more aided by medicines. Therefore medicines should be used and not an operation on the bone.

The eighth reason which can be adduced in favor of the aforesaid sect is the following list of authorities: Rhazes, *Almansor* VI, chapter 19 and in the book of *Divisions*, chapter 3, on head lesion, treating headache from percussion; Galen on the cure of headache caused by percussion, *De Simplicium Medicamentorum Temperamentis et Facultatibus* (Vol. XII K.), chapter 7; Mesue, *Grabadin*, chapter 13; Haly, *Practica* V, chapter 10, also on the care of headache from percussion; Serapio, *Breviarium* I, chapter 12; Avicenna, *Canon* III, fen 1, tractate 2, chapter 26, p. 178r, where the wound is to be handled with medicines and not an operation on the bone; likewise Avicenna, *Canon* IV, fen 4, in the chapter on skull fracture seems to agree. Niccolò also says to proceed in the same way when there is much pus in fissures or when there is only one large fissure and there is nothing beneath it and the bone often a bandage and a plaster and cooling agents will suffice. The better method is to pour tepid rose oil on the fissure, then draw the edges of the wound together, pour some head powder on it and place there wads of cotton soaked in styptic wine with oil; then bandage and allow the patient to remain quiet. If he becomes delirious make him sleep and draw blood from him if necessary. In *Canon* III, fen 1, tractate 3, chapter 14, and end, on wounds of the head Avicenna says the beginning of the cure consists of plasters and it will be quickly cured when one follows the method as shown by famous physicians with medicine and not with an operation on the bone.

The ninth reason corroborating these statements is that in the cure of *carabitus* and lethargy one proceeds with medicines which dissolve the viscous pus in the membranes when there is no opening in the skin or elsewhere. Thus medicines can do this in lesions where the way is open for drawing pus to the surface. Therefore medicines should be used and not an operation to move the bone.

The tenth reason in their favor is that before the continuum of the surface is broken there occurs a bad complexion and the pus runs to the injured spot. The wound is not cured unless a good complexion is introduced as Galen says in *De Ingenio Sanitatis* III, chapter 4, and Avicenna, *Canon* I, 4, and IV, 4, and also unless medicine resolves the humors which have run and the bad complexion. Thus medicines should be employed and no operation on the bone.

The eleventh and last reason and more useful and favorable to the sect itself is the fact that it is widely known that many are cured without incision and moving the bone, that patients are less frightened by this procedure as well as their attendants and others. Therefore the general public approves more of this method. Such is the report which all people spread abroad. It is by no means false, says the philosopher. Therefore medicines should be used and not an operation on the bone nor should such labors of medical care be expended on the case.

The Third Sect*

Another sect which often intends to cure lesions of the head asserts that it can be done correctly in no other way than by moving the bone aside and elevating it together with the application of appropriate medicines. There are famous physicians both ancient and modern who belong to this sect.

Of the previously described two sects no one has yet been found worthy of belief nor any famous author. This is really not remarkable, says Dino, because the ancient physicians who searched into hidden causes and discovered their effects did not know any such practitioners who healed with the use of medicines alone.

But since it appears to be impossible for learned and experienced physicians to practice by using medicines alone (as will appear below) and to heal head lesions as the second sect asserts therefore another mode of procedure and another way of treatment has been found and approved by the aforesaid famous authors of the third sect.

Galen, *De Ingenio Sanitatis* VI, chapter 6, at the end, speaking of the instruments with which a bone of the head is removed and opened, says: "I do not know any medicament useful for this purpose in the bones of the head" and in the same passage he also says: "If we wish to find a medicament suitable for this operation we will find none which is sufficient without a ligature or bandage. By necessity we must uncover the place of the fracture from everything upon the bone so that the bone alone remains in view until we can cleanse the putridity in the wound and dry it up." This ligature cannot be made on the head itself as he said: "The ligatures which I spoke of in the fracture of the bones of the head cannot be suitably made in the fracture of the skull nor can we prevent pus from collecting in it or expel the pus which it has collected. Unless the two are removed from the bones they cannot be healed. For example, suppose the brachial bone is broken as far as the marrow and not ligated or bandaged. When this situation exists the pus on the outside is collected under the skin and on the inside in the marrow before it putrefies. Then the entire bone as happens most often we see is not ligated as it should be. Therefore when such a thing happens in the brachial bone how much more will it

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*On the three sects described by Berengario, see Galen, *Definitiones Medicae* (Vol. XIX K. 353) and Charles Singer, trans., *Galen On Anatomical Procedures*, Oxford University Press, 1956, pp. xv-xvii. The founder of the methodists was Asclepiades, and Soranus was a typical adherent of the school. The dogmatists emphasized theoretical principles; their best representative is held to be Celsus. The empirics were a group of non-thinkers who rejected theory and relied solely on personal experience. See also Agnellus of Ravenna, *Lectures on Galen's De Sectis*, Buffalo, N.Y., 1981.

happen in the bones of the head where it cannot be bandaged or ligated. Thus we cannot dry out the fracture since it cannot be compressed with a bandage."

Avicenna also in his chapter on skull fracture says: "Concerning those things which are harmful and cause it to be necessary is the fact that from other bones than the bones of the head the bandage drives back the pus and cannot be placed on the head. Thus it is necessary to accept the bone and the fracture as it is in which there is a quantity of pus until the poison goes out of it. Likewise, if the poison happens to lie between the bone and the bandage pressing down on it the poison already generated will penetrate from that place to the marrow. We would then have to open and cleanse the wound in whatever member other than the head. There is all the more reason for completing the process in a head wound."

In addition to Galen and Avicenna, Haly, *Practica* IX, chapter 84, belongs to the rationalist sect, as does Abulcasis, *Chirurgia* III, chapter 3. So does Zoar (Avenzoar), *Theizir* I, tractate 2, chapter 1. He says if the incision penetrates deeply it requires the surgeon and manual operation. One must first begin by separating the membrane from the cranium, making an incision in the form of a cross and then using excoriation the broken bone should be removed. Averroes, *Colliget* VI, chapter 26, says if the fracture in the cranium penetrates to the membrane then it is necessary that the bone around the fissure should be removed in order to cleanse the membrane of bloody pus to prevent it from corruption. If this is not done the wound cannot be healed, but in this place now there is to be found no one who knows how to do it.

All the prominent and famous physicians seem to agree that sometimes in a fracture of the cranium which is suspected of penetrating and even when it is not suspected of doing so it is necessary to remove the bone unless it has already been moved sufficiently. Galen and Avicenna among others approve the necessity of this removal with the reasons adduced by them.

Assuming that a bandage can be placed on the head it would be sufficient for a cure because it would prevent the pus from flowing to the wound or, having flowed there, to expel it outside the head. It could not prevent the pus from flowing within nor to transmit it to other places as a bandage does in other bodily members because the shape and substance of the head would form an impediment to this.

Since the bandage cannot prevent the pus from flowing within or transmit it to other places after it has reached the wound nor can there be found a medicament sufficient to do this, as Galen says, and because only one of the three methods, that is, bandage, medicine, or removal of the bone is required to accomplish a cure we must necessarily come to the moving of the bone since none of the three is always effective, as appeared above.

I have thought I should describe in detail the three aforesaid methods of approach to a cure since they are of great importance and utility not only to patients but to physicians.

First, I say what was previously seen that there are solutions or breakages which take place in the head and what are their particular forms. Experienced and skilled practitioners of this art know what the cranium is.

Second, I say that the cure of a skull fracture, suspected or manifest, must be carried out by moving the bone unless it is sufficiently moved already, but it can be done also with medicines at the same time because I believe that in no way can lesions of the head be cured generally with medicines externally applied or drunk as the first two sects assert because such head fractures are not similar to fractures of other members, for the reasons given above by Galen and Avicenna. Pus and poison beneath the bone cannot be cleaned and dried out unless a free exit is provided for them by moving the bone. Nor can medicine penetrate to the depths of the lesions to dry it out. Thus due to the nobility of this member pus cannot remain in the place without inducing corruption of the member from which death will indubitably result.

Yet we must point out that there are some cases in which medicines alone are sufficient to heal without elevation and moving of the bone. Such cases are those, as Dino says, in which three factors are present, namely, the body has good chymes in quantity and quality and on account of a good physical disposition there is no fear of a flow of humors to the site of the wound. Much care must be taken with this flow. When the orifice in the skin and the flesh is quite ample as is the fracture of the bone a free exit for the pus is provided. Also since the bone is not being rubbed and is not pricking, compressing, or burdening the membranes and the membrane is not rubbed and contused (after which it would putrefy) and since the expulsive force is strong, medicines which cleanse, dry out, and attract can be applied to soothe the pain whenever it occurs. If all these factors are present we say that no wound exists which cannot be cured with medicines and without any manual operation on the bone as long as the patient cooperates with the physician and the latter is legitimate.

Nevertheless, such a manner of cure is not to be chosen, that is, with medicines alone because it rarely happens that in the majority of cases the aforesaid favorable factors are all present. But if they are or at least a large part of them it is possible to effect a cure. Hence these empirics believe that they can always heal a patient because now and then they have done so with their plasters. It is this which deceives the general public, says Gentile, that is, they have cured such lesions in which there was a large fracture in flesh and bone and the patient recovered. But it seems sometimes quite the opposite in a capillary fracture in which the bone is moved aside. They argue without further consideration that this patient has been cured by the application of a plaster, although he suffered a large fracture. But the patient who suffered a small one died because of the moving of the bone and they suppose that if he who died had been cared for with plasters he would have survived. Seeing this and believing this they glorify and praise their plasters and their use of medicines instead of an operation on the bone.

Because these men are ignorant of the effects of causes and do not know how to distinguish the dispositions or true nature of wounds but administer such plasters indiscriminately in whatever wound they kill many patients, which they would not do, as Dino says, if they knew how to distinguish between wounds. Although such a method of cure without moving the bone may be possible it is nonetheless safer for the physician to elevate the bone and to adhere to the rational mode of procedure.

As to the contention that these plasters of theirs and other medicines either have the strength to attract or to produce flesh for the wound or are repercussive and comforting there are many reasons, says Dino, why the plasters or other medicines should not be administered even if they have the power of attraction. Their use is, to begin with, suspect and bad because they draw many humors to the site of the wound and thus cause abscesses since at the beginning of the treatment the humors run out and do not need attraction at that time but repulsion and comfort in the wound. Therefore from the beginning it is better to place rose oil upon wounds and lesions of the head.

The use of incarnative medicines [i.e., those which promote the regeneration of flesh] is also suspect from the beginning because in many cases we are not certain of the effusion of humidity upon the membrane and also between parts of the split bone; also, as very often, the patient's body is not clean. Then a quick drying out is not possible in many cases because some humidity present in the wound when flesh forms in it flows from above downward between parts of the fissure. Unless this humidity is removed and dried out it will cause the other parts of the fissure to putrefy.

It is rare that such lesions do not turn into ulcers because the shape of the head does not allow it to be constrained with what is called an incarnative bandage. Hence these lesions often turn into ulcers and humidity continually increases in the ulcers because of the reason set forth by Galen, *De Ingenio Sanitatis*, III, chapter 3, where he says that nevertheless two humidities are generated in wounds, one thick, the other thin. These arise not only in wounds while the flesh is being restored to them but also in the entire body. The thin humidity is created because it is dissolved from the body by a hidden process and sometimes openly. The cause of this is the loss of natural heat or a large amount of food taken beyond measure or too much strenuous exercise which reduces the bodily strength and makes the body slack. The thick humidity becomes yellowish in our bodies. The thin humidity moistens the wound, the thick one putrefies it. Thus two medicaments are necessary, one to dry up the humidity which moistens the wound and one to clean up the putridity. Since nature does not cease to act it is necessary that these humidities should arise in wounds. Therefore, there is no time in which the two medicaments are not necessary to alleviate the situation.

Therefore, from what has been said one must conclude that an incarnative medicine is not suitable at this stage in the cure because it does not dry out nor clean away such humidities and thus by enfleshing, that is, solidifying these puses it closes up the wound and causes them to putrefy within it. They impede the cure and bring on death.

If in truth such medicaments had repercussive and comforting virtue then there would be reason to use them without moving the bone as well as the cause of retention of the humidity which collects and is retained there to putrefy and bring on death. Therefore, I say that the use of medicines alone is not suitable because it is not sufficient as in many cases, especially when these empirics always proceed with one medicine at the beginning, middle, and end of the cure although one man uses one medicine and another man another because there are as many medicines as there are practitioners.

Since the physician should always choose the safe way to health he ought therefore to choose this rational sect. Hence prudent Avicenna said there is no way to avoid the process of collection, detection, incision, and prevention of incarnation until you are secure, that is, that there is no fear of the flow of pus to the interior of the bone we have incised. As long as the pus does not run to the interior region of the head it is safer to open it and lay bare the bone unless, as Niccolò said, the bone cannot be moved either because a competent surgeon is not available or because the patient and his attendants and relatives have completely refused to allow the operation, or because the patient is very ill.

Lanfranc [d. *circa* 1315, or 1350?, of Milan; wrote *Chirurgia Magna* and *Parva*] says: "I knew by long experience that many more are cured by medicines than by trepanation." He adds: "I do not use instruments for removing the bone except in two cases. The first is if the cranium is so fractured that the fractured part has descended below the healthy part; second, if some fragment of the bone puncturing the *dura mater* has been separated from the cranium. In these two cases since the *dura mater* is compressed by the first cases and punctured by the second, feeling pain it receives the running humors and develops an abscess. This is the cause of bad accidents and death. Thus I am forced to remove the harmful bone with instruments, but in other fractures I proceed in another way." He also adds, "When the objection is made to me how the blood and pus can be dried out without the elevation of the bone, having dripped through the small crack on to the *dura mater*, I answer that just as the pus which causes frenzy and, which is more, lethargy is dissolved by plasters externally applied when there is no fissure in the cranium nor a wound in the head the much better light blood easier to dissolve descending through the small crack when there is one can exhale better through it. That blood is not made viscous in the substance of the *dura mater* as it is in abscesses. Hence the better is nature's own force of expulsion, the better does it obey the attraction of medicines."

Niccolò says on the authority of some people that in two other situations the method by way of medicaments must be rejected. The first is that if there is grinding on the bone, that is, a breaking-up into separate pieces, then the cure with plasters must be completely rejected since if the bone remains thus broken to pieces inside it will necessarily become corrupt and putrefy. The second reason is if the fracture is very narrow and capillary in nature [a hair-line fracture] no plaster however strong its ability to attract can extract the filth that lies beneath given the narrowness of the fracture and the density of the bone.

Niccolò says there are many others who say that the cure with plasters without manual operation is more to be selected except in three cases. The first case is when the skin is not opened because it is already sufficiently open before plasters are applied. The second is with the breakage into pieces of the bone insofar as it concerns the separation of a splinter from the bone whether inside or outside (or of more than one splinter) since there is a skill required for moving the splinter which a plaster cannot accomplish, at least if it is a large one and also if the bone is not separated or if it is separated it pricks the membranes and must then be removed. The third case involves the bone when it is folded or presses heavily upon the membranes; such a bone must be elevated and kept from pressing on the membranes.

It is acknowledged, however, that all the operators of our time who work with plasters are ignorant and unskilled idiots who do not know how, when, and which plaster they ought to apply. Therefore it is a great danger to place a patient into their hands. But if there is found an upright man well instructed in the art of medicine who knows how to use the proper medicines rationally he should be selected rather than a manual operator.

The Conciliator also in *Differentia* 181 concedes that plasters can cure without moving the bone except in the three cases which follow: one, when bad symptoms are already present; second, when because of contusion within upon the *dura mater* the humors have flowed to the fracture and the cranium is broken, especially if the pus does not have a free exit to be purged such as a foramen sufficiently wide from which it can issue forth, or if there is such a foramen it is on the lower side of the lesion from which the collected pus cannot go forth. The third exception is when the fracture does not penetrate and its course is as aforesaid, which can be recognized by its concomitants or symptoms.

I say first and foremost that the physician ought to be a prudent man well trained and experienced in the art and that before all he must have the very best knowledge of the anatomy of the head by dissection. He should know how to distinguish one lesion from another, whether simple or complex, and in what manner it is complex. He should not trust himself alone but should have as a consultant another companion and friend, also a physician, to help decide by discussion whether the given case requires the moving of the bone or not. In this way a good end will result for the operation.

Although Lanfranc says that only in two cases aforesaid the bone should be moved and although Niccolò also by the authorities he does not name accepts the two exceptions and then three notwithstanding the three exceptions listed by the Conciliator, none the less there are other kinds of lesions in the head which call for the moving of the bone. Nevertheless, many things are contained under the Conciliator's exceptions.

I concur with the clever and diligent Dino that it is safer to move the bone in whatever of the aforesaid lesions except in those in which there exist the conditions listed by Dino since none of the aforesaid situations mentioned by me in which sometimes the bone does not need to be moved applies, especially since they rarely coincide with the conditions set down by Dino, that is, that the body have good chymes, an ample fissure, etc.

I say that Galen and his followers are quite right in saying that sometimes medicine is sufficient in the aforesaid cases given by Dino above to cure lesions in the head without moving the bone. But against the empirics it is said that we do not always need to proceed with medicines. Lanfranc and others cited by Niccolò and also the Conciliator are wrong according to Guy de Chauliac in his chapter on skull fracture as long as some kind of rupture is involved although some form of fracture is worse than another.

The truth is that Galen and other rational physicians proceed in various ways in moving the bone, now immediately, now later. I am of the opinion that the physician who wishes to proceed and operate correctly ought first to use medicines and to continue doing so until he is forced to remove the bone. The symptoms will indicate the nature of the operation as I shall say later when I discuss the operating instrument. Celsus, *De Medicina* 8.4.10, is also of this opinion on the care of skull fracture: He says: "In every case of a fissured or fractured bone, the older practitioners resorted at once to the instruments for cutting out the fragments. But it is much better first to try the plasters which are prepared for the cranium."

Therefore let the Conciliator and Lanfranc and their followers keep silent when they say that moving the bone is not to be carried out except in certain cases. I merely say that the medicines which ought to be applied before moving the bone aside ought not to be empirical medicines nor administered by empirics but ought to be rational and administered by a rational physician.

This is what Niccolò says also on some people's authority, that is, if an upright and expert man can be found who knows how to use medicines in the appropriate place and time this method is preferable to choosing an operator to move the bone.

I believe otherwise. I say a physician who knows how to use medicines and manual operation in moving the bone should be selected and the patient should commit himself to him since he will use medicines or the moving of the bone with the appropriate medicines when there will be need for each.

But one thing particularly I do not wish is that operators should be ignorant of this art but with the best intentions operate on skull fractures. In the first hour or at least the first day the skin should be opened so that if the bone must be moved such a dilatation of the skin will suffice for operation unless the aperture made by the wound is already sufficiently wide. By way of this dilatation there will follow the healing procedures described above. Let this be therefore my conclusion: in contusions, incisions, and perforations of the head let there be in charge a legitimate physician whom the patients and attendants will obey.

From what has been said we can partly resolve the objections especially of the second sect, giving little or no thought to the first sect since it is not in use except among those who depart from being trustworthy. Certainly in lesions of the head I believe less in these potions or medicines than the Jews themselves believe in Christ. But in regard to fistulae and bad ulcers I affirm that such potions are beneficial and I place my faith in them because I have often used them. I praise them in the aforesaid ulcers and in wounds of the spiritual members I have also used them and seen their good effects. Especially if there is much pus in the breast which required drying out and cleansing such potions are to be administered because there is then doubt concerning the conversion of such a disposition into fistulae. The descriptions of potions which I shall give below since they are to be used in this second instrument of medicine, that is, potions, as I promised in regard to medicines to be applied both internally and externally I intend to bring to an end so that something may be said in my work concerning each sect.

The first reason for the use of these medicines is that a cure can be achieved with fewer means. The response is that the bone must be moved aside when medicines do not accomplish their purpose.

The second reason is that it is better to proceed without exciting fear in the patient. But when medicines are not sufficient resort must be had to a manual operation. In this deed one must seek as much as possible to avoid giving pain, rupture, and perforation although sometimes pain is the medicine of pain.

Third, it must be said that medicines remove filth and all humidity if they can reach the depths of the injured area. They penetrate much better if the bone has been moved.

Fourth, it is to add evil to evil, etc. I say that by moving the bone evil is not added to evil but removed nor is there as much danger in operating on the bone as some people think.

Fifth, medicines which dry out pus in the areas of possible exit for it are to be given, etc. But to desire complete drying out of pus in the depths of the head is to expect death because of the nobility of the member, for in the nervous and noble members the maturation of pus in the exits is not to be expected, as Avicenna says.

Sixth, medicines which attract bones and thorns are to be administered. This is true but they do not act so quickly and there is danger in delay of the pus, as above.

Seventh, the pus can issue forth through pores and a fissure. It must be said that it cannot always do this either because it is thick and abundant or because the expulsive force is weak. In these cases the medicine needed at the time will not assist because the pus will issue slowly and thus death will follow.

Eighth, because Galen, Serapion, Haly, and so many other skilled authors proceed with medicines it must be said, as some say, they do so since they know how in that fracture where the bones are sufficiently moved aside but not in a capillary fracture.

Some say that the discourse of the aforesaid authors refers to damage to the head when the cranium is not fractured. Some say that the aforesaid authors intend to show that such a method with the use of medicines is sometimes possible, and they say that Avicenna understood it thus in his chapter on skull fracture both with fissures and without them. They also say that when the aforesaid authors speak of headache they mean only the method of cure with medicines since their intention is not to speak of head wounds but because they presuppose that they have spoken sufficiently elsewhere concerning those fractures with manual operation in moving the bone. Therefore, they have spoken thus much concerning medicines but intending it to be understood only of sedation of headache pain.

To this applies what Avicenna says as to beginning the cure with plasters, etc. He wishes to begin with medicines because health is more quickly achieved in this way, as I said above, beginning with them and proceeding thus to the end unless something prevents such a procedure, or if a roughening, rasping, or an incision in the bone retards the cure. The rectification or healing will be swifter if we are able to use medicines alone.

Ninth, the cure of *carabitus* and lethargy is possible with medicines. I deny this assertion because the pus in an abscess is not so putrid or bad if it finds exit from the wound and is not consolidated and collected in one place. Thus it is less harmful and more adapted for being dissolved. Nor is the head so weak in expelling it as where there is a wound.

Tenth, one must bring about a good complexion before using medicines. I say that the moving of the bone removes a bad complexion sometimes better than medicines do because it provides a way for purging the pus which induces a bad complexion. We ought to use the moving of the bone when medicines bring no help.

Eleventh, it must be said as Dino says that we should pay little heed to the report which lay people and common folk put forth concerning medicines. They do not know what constitutes the art of medicine because that report is erroneous and has no truth in it.

Thus by means of these statements and counter-statements I think the objections of the second sect can be resolved and indeed effectively refuted.

Continuation of the Cure of Skull Fracture By the Use of Medicines

To continue the use of medicines as the basis of a cure we shall begin with Galen, *De Remediis Parabilibus* (Vol. XIV K.), the chapter on headache from percussion. He says: "It often happens to those who fall among ruins from a high place that some one's head is broken either near the brain or the membrane. A rather intense headache results and the entire disposition of the wound becomes very difficult to cure and in a more pressing danger. The best thing to do in this situation if age does not prevent and the vital power is not too weak to allow the performance of phlebotomy is to use successive embrocations on the head, pouring oil on pieces of wool and covering the wound with them."

But if we are prevented by one or both of the above adverse conditions from letting blood we shall evacuate the bowels with a clyster. There are an advantage and a relief in evacuating them but an even greater gain in its revulsive effect on the humors which are accustomed to be carried to certain parts of the body. Then we use the clyster as an aid against swellings and inflammations. All this doctrine is found also in Rhazes, *Continens* I, on the authority of Galen.

From what has been said the excellence of clysters is recognized in lesions of the head because they evacuate and divert when other medicines perhaps do not do this. Clysters are also praised by Serapio in the cure of headache from percussion among other medicines. He says the clyster evacuates by a better way since below it is farther from the location of the wound and contrary in its direct straight line and thus attracts matter in the opposite direction from the area of the illness.

The cure by phlebotomy is to be begun unless a sufficient amount of blood has already flowed from the wound. All authors agree that phlebotomy must be used, Serapio, Haly, Avicenna, and others in the cure of headache caused by percussion.

Let blood be let at the first hour, says Paul of Aegina, Book IV, the quicker the better. Haly, *Theorica* V, chapter 10, says: "He who has a headache caused by percussion or a fall on the head should be blood-let quickly. The blood should be drawn as strength permits. Before phlebotomy the bowels should be evacuated either by nature or by art."

Niccolò says: "They say that as soon as you reach the patient after the percussion find out if he still has undigested food in his stomach and then provoke his vomiting. If the food has descended from the stomach order a lenitive clyster. Then perform phlebotomy. This is said in *Continens* XV."

I say that drawing blood is dangerous before the digestion of the food in the stomach and middle intestine has been completed since when the blood is let something of that which is in the veins and stomach is drawn to the liver and its *meatus* because of their emptiness. It is not fitting that because raw blood should be drawn the humor in the veins should become raw. This is harmful to the veins since the blood is not digested but putrefies and will increase fever or bring on something worse. Thus the letting of blood must be done when it is opportune, after digestion is completed. The indication of this will be a yellow urine and an alleviation of the body due to a moderately aroused appetite for food.

Avicenna, *Canon* I, 4, on phlebotomy says you should beware of drawing blood when the body is full of food lest you draw the latter when not yet properly prepared to the veins in place of the blood which you will have evacuated from them. You should also beware of repletion caused in the stomach and intestines by the feces which have assembled there. Be careful to remove them and what is in the stomach and the lower intestines in whatever way you can, including the use of vomiting, and if in no other way than by means of a clyster.

Those men in common practice avoid the use of vomiting in ills of the head but await complete digestion and use a lenitive clyster if nature has not performed her task. Then they let blood. On phlebotomy see Rhazes, *Continens* I, and Avicenna on cure of headache either from the cephalic or the black vein. Rhazes suggests that blood be let four times in two or three days and this in a weak body, but Niccolò says blood should be let in the customary way and even in those from whom much blood has flowed from the wound. Nevertheless, in this case the moderns approve cupping glasses and some recommend leeches and cupping on the shoulders and buttocks. Generally leeches are applied around the veins of the anus. The moderns also observe this rule: if there is no plethora they draw blood from the cephalic vein on the opposite side to the wound. When there is a plethora they draw blood from the black vein [medianvein]. If there is a larger plethora they draw first from the black vein, then from the cephalic, and sometimes from the basilica vein or from the longer veins of the head according to their degree of fullness because the more full they are so much the more must blood be let from the long vein. Note that the process should not be prolonged because it would weaken and not draw blood forth from the injured area.

Note also that blood letting above other forms of evacuation or lessening helps to prevent an abscess as is intended in the beginning of all aforesaid lesions of the head. Avicenna in his chapter on skull fracture alone prescribes blood letting. He says that if the cause of a hot abscess is manifest then the cause must be cut away swiftly since if it is hidden, that is, if it arises from a repletion of humors then you should try to separate it and use phlebotomy of the vein if there is nothing to prevent this.

Avicenna's reason is as follows, and Dino says the same thing. Usually the abscess occurs from the flow of blood rather than from that of the other humors. Then because blood is particularly fluid both because of its greater abundance and its nobility blood letting is an evacuation with particular distractive force. Since the abscess is generated from this beginning, that is, from the flow of a humor, therefore it attempts to withdraw to the side opposite the wound. Phlebotomy accomplishes this withdrawal quickly. Avicenna mentions phlebotomy rather than any other means of evacuation.

It is true that there are other means, for example, by the use of drugs, especially helpful for an abscess which perseveres; Avicenna speaks in the same passage referred to about such an abscess. If the hot abscess perseveres and there is nothing to prevent it some solvent medicament should be used once on it, as Hippocrates also advises.

Dino says that suitable drugs are of benefit in a persevering abscess because then the evacuation of the humor contained in it is required. Avicenna says the drug ought to be a gentle solvent used once so as not to increase the inflammation as strong medicines do. Such medicines of gentle effect are cassia, reed, Indian manna, and such like; sometimes some people use rhubarb and agaric. Dino says that Paul of Aegina says the solvent drug should draw out the bile. Paul is quite right because the abscess generated in the membranes from thin pus always contains bile mixed with blood and other humors. Hence the bile must be evacuated but with a gentle medicine for the reasons stated.

Nonetheless, Serapio and Avicenna on the cure of headache due to percussion prescribe phlebotomy and then clysters, quite sharp with salt and *cucumis colocynthis*. Serapio says there are two advantages in a clyster: it evacuates and diverts. It should be sharp or acute if there is no fever present. But if there is fever the clysters should be modified, that is, not made acute nor too light because then they would neither divert nor evacuate. If the clysters do not help he recommends that cochia pills should be given the patient if he has no fever. But Avicenna says that if he has heat which is less than that of a fever you should not omit the medicine named above for the evaluation is necessary so that there will be security for the abscess. Note, however, that such pills and such clysters are not to be administered unless the complexion of the patient is cold, his body robust, and at a time of cold temperature when he has no fever. The reason for this is given above. It is true that lukewarm clysters which draw out the feces are wonderfully beneficial up to the time of the consolidation of the abscess. Beyond this point the clysters should be lenitive to soften the feces as much as they can and to draw them forth with a decoction of mallow, blitum and violet leaves or red sugar or boiled wine with oil mixed with salt and egg yolk.

At the time when the formation of the abscess is still in doubt put some mercurialis [*chenopodium bonus Henricus*, or angular-leaved goosefoot] in a decoction with some *hiera picra* [holy bitter] and cassia although cassia is also convenient when the abscess has formed completely. If the patient is suffering intensely from fever let some lettuce and endive be added to the decoction. Some people make stronger clysters by adding *stichas Arabica* [*lavendula stoechas*] and *parietaria* [wall pellitory], two handfuls of *diaphoenicon* [an electuary made from dates] and the same amount of holy bitter and *cucumis colocynthis*. Such biting and drawing substances are useful especially when there is doubt concerning the formation of the abscess.

When the evacuations have taken place, that is, when it is recognized that the body is well cleansed, we must turn to local remedies because physicians ought not in this middle part of the cure to resist a rational approach. However, antidotes can be used more rationally when the body is cleansed. Let this be the local cure, preliminary to the full cure.

First and before all, as Avicenna says in his chapter on headache, if the wound is in the head temper the complexion before treatment begins. Notice, reader, that Avicenna and Serapio do not understand these words to apply to a wound which penetrates further into the head since they mean rather the cure of the abscess and sedation of the pain of the wound than anything else. When they speak of medicating the wound before and tempering the complexion they also send us to other passages in their books in which they speak fully about the broken continuity in the head. Avicenna does so in particular. Therefore we must recur to his chapter on skull fracture, *Canon* IV, fen 5, and II, fen i, on head wounds. There he lays down the method of curing wounds and removing a bad complexion which I have described above on the cure of external wounds. This method is suitable also for internal wounds.

I have more to say about antidotes in connection with the cure of external abscesses. Lest I become tedious in citing authorities I will mention only one, the highest, Avicenna in his chapter on headache because the same remedies and treatments are given by Haly and Serapio as by Avicenna, who says if the abscess is not completely formed a plaster may be applied to the area for comfort, such as water of myrrh and willow, oil of myrrh, lily, and rose, with mixtures of these in which there is an astringent quality, a thinning effect, and an ability to dissolve the abscess somewhat. Other ingredients can also be used such as rose, camomile, melilot, aromatic reed, and *bole Armenian* [a red, clayey earth made into small stamped cakes used as a styptic] and alum used as a medicament with aromatic wine. Perhaps you will be content with oils from these ingredients used in tepid form. Probably the pain and fear aroused by the abscess will make it necessary to cool them somewhat before applying. Avicenna also says that if the area of the wound begins to form an abscess then it is necessary to apply cold styptics such as pomegranate peel, *balaustia* [pomegranate flowers], *ervum lens* [lentils ground into meal for a poultice] and roses in an embrocation for the head made from a dilution in water made into a plaster. This should be changed later for a plaster which causes thinning out, such as that made of cypress, myrrh, citron, *olibanum*, etc.

The medicines mentioned by Avicenna should be well mixed, in my judgment. All of them are styptic although the oily ones are less so with the exception of oil of lily, which is not styptic. These medicines are intended in part to halt the flow of humors to the head before the abscess begins to be formed; they comfort the head in the area of the wound without a strong stypticity. In part also they are intended to prevent an abscess. When it has already begun to form it should be treated with stronger stypticity and partly when already formed and in its decline with substances which thin out the pus and dissolve it.

Since this is Avicenna's opinion one must consider whether the head becomes abscessed because of the existence of a wound or not. But we must say this not because he has said it for if there is a wound it should be medicated first. Then he says if the wound is not complete, as Jacques Despars says, then the wound is to be treated with a plaster. It is said therefore that these plasters are suitable where there is no wound. Thus he describes the care of humors which flow and cause an abscess in a contusion of the head without a wound and he cannot be understood otherwise.

Let us say that such remedies are to be applied with caution but not on the very site of the lesion because at the first hour when the skin is not broken in the contusion the humors which principally create an abscess runs swiftly to the exterior of the head. Thus these remedies are not appropriate for the wound because they harden the pus, render it difficult to be dissolved, and would perhaps cause putrefaction of the member which is much to be feared in the head when pure repercussion of the humors is not suitable due to the notable increase of the abscess, as Avicenna says in *Canon* I, 4, and IV, 3, on the cure of abscesses as to the times of their development in general. The medicines are not suitable because such an abscess is created by a primitive cause. Avicenna, *Canon* I, 4, prohibits their use because of their primitive causation when the repletion of humors ought not to be medicated at the beginning of the treatment with medicaments which will cause them to flow and to dissolve.

It appears therefore that such medicines ought to be applied around the area and not in the abscessed area itself insofar as their repercussive power is concerned. I should however believe that according to the general facts a repercussive medicine can be administered in the cure of abscesses of the head even for those within the head and in other members as far as these abscesses are created by a primitive cause, especially if that cause is a wound and not a contusion since through repercussion in the wounded member pus is not retained nor solidified, whence arises corruption of the member. The member should be soothed and the pus always requires softening and dissolution. Avicenna said that he who uses tepid warm oils is doing the right thing, especially with rose oil and myrrh since these form a medicine which dissolves the pus gently and is lightly styptic, bringing comfort to the members. The other authors agree in this treatment.

There is only one cure for internal abscesses created by a primitive cause, that is, to prevent their formation, because when it is formed it is rarely averted, as Avicenna says in his chapter on skull fracture. Its local treatment can be completed with rose oil. Sometimes plasters made of althea, fenugreek, linen seed, and camomile can be applied as an embrocation. Barley, linen seed, water, oil, chicken or goose fat are also used. An anodyne of oil is dripped into the ears, the head, neck, and vertebrae are anointed with it, and the patient is made to sit in warm water and rub himself with these oils.

Evacuation or elimination also at such a time, that is, as the abscess is beginning to be formed, is suitable with light use of drugs as described above. This is a sufficient discussion as it seems to me of Avicenna's chapter.

Rhazes, *Continens* I, on the authority of Apollonius, says a better medicine for abscesses is to render the bowels flexible, to diminish the intake of food, and to omit wine. On headache from percussion he says if headache is caused by an abscess a better cure is blood letting and clysters to remove the feces. If the skin is unbroken use rose oil and vinegar on it. If the abscess and the headache are severe omit the vinegar and use only rose oil. When the abscess is in its decline use emollients. If it has become hard place mint, wormwood, and such like on it.

He speaks thus, and I have found the following medicine written down as helpful in a percussion in which the brain is shocked, and I have often used it. I have found it most efficacious, but I do not know its author. Recipe: take myrtle and vine leaves, mint, earth *sansucus*, make a plaster of them and apply to the head. He also recommends warmth, tepid oil but no wine, bathing, or warm foods. In such headache due to percussion phlebotomy should first be used. Then the juice of willow leaves and myrtle, oil of lilies, aromatic wine, myrrh, melilot, aromatic reed, alum, and *bole Armenian* should be mixed in a plaster for the head. Defecation should be stimulated and the diet made thin.

Headache from percussion should be treated as follows. Warm the head with a woolen cloth dipped in warm oil, stimulate defecation gently, avoid the sun, bathing, wine, acid foods, and sprinkle hot water on the head. If the head is wounded place pulverized resin or aloe and incense mixed with honey and bind the mixture on the head with a bandage. You see, my reader, that the medicines prescribed by Rhazes are not predominantly styptic. The text of Avicenna on headache from percussion appears to have been well expounded by me.

Why Avicenna Does Not Use Doses of Local Medicines in Many Places

One other matter I do not wish to pass over in silence, the fact that many people wonder because Avicenna in one chapter prescribes many medicines of different complexions for whatever illnesses. They wonder also because he does not prescribe the exact doses for each medicine if it happens that they are compounded for use in a plaster, liniment, or some other local remedy.

To these people in their wonderment and doubt I shall say what occurs to me. I say that a physician cannot put together precisely the medicine which will be completely suitable for an illness so that it will be demonstrated that one medicine is the right one for one age or another or for one complexion or another nor for one time or another.

Considering this situation Galen, *De Compositione Medicamentorum Secundum Locos* (Vols. XII-XIII K.), chapter on headache from percussion, says: "The disposition of the illness indicates to us the quantity of each assistance required for each patient and the particular difference in the ingredients of the medicine administered. The mixture of humors and other factors in the constitution of the individual patient are also forms of evidence for the dosage. His vital powers, his age, region, and the season of the year, his present health and so forth are all to be considered."

Someone may wonder why Avicenna did not prescribe doses of medicine here or elsewhere especially when Galen also in *De Ingenio Sanitatis* II, 3, says this dosage cannot be revealed, written in a book or told by some one else. One thing is clear, however, the true quantity of each ingredient in the medicine. Galen, nevertheless, says we can approximate the doses with some indications of the required amount.

Let the physician be discreet, consider the aforesaid discussion, and apply hot to hot and hot to cold and other contrary qualities to similar purposes as is required in the preservation of similars and the removal of contraries.

It is true that the physician cannot find the precise amount of medicine required for each patient unless he has practical experience in its administration, as Avicenna says in many passages and first in *Canon* IV, fen 4, tractate 1, chapter 11, p. 448r, on medicines which cause flesh, i.e., scabs, to grow in wounds. There he says that experience gives us the information about medicines which dry out and maintain stability based on the growth of flesh according to progress and continuity or from the continuing worsening of the illness. He also says that when one medicine fails to help you should turn to another. Sometimes also there is a certain relationship between some bodies and some medicines which exists without their actual administration, such as strong medicines for strong bodies and weak medicines for weak bodies. He also says you should know which medicines cause scabs to form in a body or member and which do not depending upon the individual bodily complexion. Second, you have learned perhaps what is superfluous in a body and what is not and that there is not a complete removal of the superfluity although a given medicine may require a certain drying out and removal of humidity adjusted according to the body involved but not with complete accuracy. Likewise, he affirms in *Canon* IV, fen 4, tractate 3, p. 453r, on the cure of ulcers, that a certain medicament causes certain bodies to grow flesh while certain ones are corrosive accompanied by strong abstersion when the bodies are light. He also says that you must heed what is necessary among them which will or will not cure an ulcer. The suitable medicament may not be helpful in its general disposition but it is not harmful in effect and an unsuitable medicament is more diversified since it is weaker.

This indicates a necessary addition which is contrary to what is expected of it in relation to drying out and cleansing. One medicine may be better than another in relation to its weak effect wherefor an addition must be made to its strength, or it may differ for various other reasons. For example, it may heat more than necessary, creating redness and inflammation. Hence it must be reduced in strength and its inflaming effect removed by the use of a plaster which cools the body.

He also says that often a medicament is not suitable because the complexion of the patient contains superfluous heat so that the medicament must be stronger to counteract the heat and reduce it to that of his normal complexion. Or he may be deficient in heat which is proper for him. In the same passage on the cure of ulcers he says that when you administer medicament and do not find the humidity lessened or you see it increase then you know that the medicament in relation to that body is not one which dries out. Then you must add to its power for comfort and for more drying out and assist it with some small abstersion.

This is the tone also of *Canon* IV, fen 4, tractate 1, chapter 6, on the care of wounds which have abscesses and pain. You must observe the nature of the change in the abscess. Thus if you administer a black unguent and you see the wound becoming violently red and forming blisters change the medicament to one which cools and use a white unguent. If you see that the wound is softened or hardened you should administer now a white, now a black medicament.

He is of the same opinion in *Canon* IV, fen 4, tractate 4, chapter 2, p. 457r, on the care of broken continuity of nerves. You should be careful in your prescription of medicines that they should not heat the patient beyond necessity nor be deficient in their ability to heat. The situation is similar in regard to abstersion and drying out and their opposites. When you see that the member is already heated then cool it, that is, with some measure which reduces the heat. When we experiment with wax mixed with *euphorbia officinalis* upon the leg of a healthy man similar to the patient in his complexion and his form and we consider whether they are superfluous in calefaction or it does not heat him with a temperate calefaction then the medicines should be administered according to the required heat afterward to the patient. From what has been said anyone can understand why in one chapter of Avicenna there are descriptions of diverse complexions and the powers of medicines and this is why he has not prescribed dosage.

Consequently let us say that the physician ought to be of good judgment because medicine is not handed down in writing except in a general way. These words should indicate whether a medicine, simple or compound, can be found in the exact degree necessary for removing an illness or preserving health. Thus if our medicines described above and to be described below are to be prescribed by some one they ought really to be prescribed by measuring their effect, as the divine Avicenna says, and the physician should change them and use them in accordance with their effect and thus acquire the name of a legitimate physician.

Now let us turn to the remaining part of the medicines suitable for the aforesaid dispositions of the head. I say that in whatever lesion as I said above the head should be shaved lengthwise and then rubbed with a warm cloth to open the pores. Next, the entire head should be covered with an unguent or a plaster or other medicine for the reason stated earlier. In the portion of the head upon which such treatment is employed let many incisions and perforations be made so that the vapors may issue forth more freely. In consideration of the temperature of the air the head should be covered with cloths, a cap, or other means and a bandage which does not cause pain by being too tight. Such treatment should not be given except under conditions of heat moderate both in actuality and potentiality in the first days and before a sufficiently effective evacuation has been achieved.

Niccolò on other authority says that if the fracture is near the sutures of the skull it is more easily cured than if it is at a distance from them with a considerable opening in skin and bone since by reason of the sutures the pus is more readily dissolved and evaporated. He says that the placing of tents in that place is not required as it is elsewhere especially in the skin but that a piece of cotton containing a carminative remedy should be placed on the bone. I am one of those who always recommend light tents between the lips of the wound because this is a safer method.

The manner of composition of the residual medicines which aid the aforesaid lesions is as follows. First, there is the plaster invented by Andromachus which extracts thorns, bones, weapons, and seals such wounds.

Recipe: take twenty *aurei* [one *aureus* = 2 dr. 14 gr.] each of the grains found when a palm is broken called *armeli* or *aumeli*, red barauc, ammoniac gum, *aristro*, *cretica Ra.*, donkey cucumber, and turpentine; ten *aurei* each of pepper, macro pepper, ammonia, *amomum*, xylobalsam, thyme, mastic, myrrh, dry resin of viscous oak, milk, *arbor mori*; thirty *aurei* of wax; fifteen *aurei* of goat sepi; oil must as much as needed to make a plaster and crumbs of bread to be used as a roll of plaster which are made soft or kneaded with the hands smeared with lily oil. Keep for use and administer.

Another unguent is that of Master Anselmo da Porta. This consolidates broken bones and draws the blood and pus from under the bones. Recipe: six ounces of turpentine, three of wax liquefied in vinegar and kneaded daily, then separated from the vinegar. Add woman's or cow's milk or donkey's to the weight of one pound and a half, boil together with a slow fire for half an hour, then add three ounces of betonica juice, powder of the herb *tunisius*, that is, of an herb called peas whose roots resemble those of a very good herb (except that the cellular structure [diploë] of these herbs is yellow in color) and are aromatic. It is good to heat this mixture over a slow fire or in the sun and make an unguent of it. Administer as above.

Another tested recipe: take two *drachms* of Greek gum, four of resin, six of wax, four of rose oil, two of ammoniac, three of turpentine, five of betonica juice. Make an unguent.

Another recipe: three *drachms* and one-half of turpentine, two of white wax, one and one-half each of vinegar and rose oil, two and one-half of mother's milk, five of *betonica* juice. Make an unguent.

Another tested recipe: some say that it consolidates all ulcers and the wounds of a broken cranium. Take one ounce each of pine resin and wax, three ounces of turpentine, two ounces each of pulverized *betonica* and *centaurea*. Boil these all in a sufficient quantity of wine for a considerable time. Strain and add three ounces each of mother's milk and *betonica* juice and two ounces of vinegar. Make an unguent.

Another recipe: take two ounces each of wax and turpentine, two ounces and one-half each of *centaurea major* and honeysuckle. Boil together in wine, strain, add four ounces of blessed oil. Make an unguent.

Another recipe: take one pound of resin, half a pound of turpentine, half a pound of wax, four ounces of mastic, four handfuls each of *betonica*, anise, melon seed, verbena, sedum. Boil all in a sufficient quantity of wine, strain and add one half pound of mother's milk. Make an unguent.

Another: take two *drachms* of Greek gum, one half *drachm* each of *opoponax* and *bdelium*, one drachm each of resin and wax.

Another plaster called bovine commonly used by Florentine surgeons and by Pietro d'Argelata [*Chirurgia*, etc., Venice: Giunta, 1531] is called honeysuckle unguent. Take four ounces each of resin and wax, two ounces of rose oil, four ounces of pulverized honeysuckle. Boil in good wine according to the art and make an unguent.

Another tested recipe: take two *drachms* each of the juice of the cowslip, *betonica*, clove, honey suckle, anise, then three of turpentine, one-half of *bdelium* two of wax, one ounce of good wine, half an ounce of mother's milk. Boil on a slow fire until the juice is consumed. Then add two *drachms* each of *aristolochia*, rose, and *betonica*. Make a plaster.

These plasters or unguents described above are listed and recommended by Dino and Niccolò. I shall give other local remedies from many other authors, but those in which I place greater faith are those written down in this entire book and marked as "tested," that is, by me.

The plaster of *centaurea* [thistle] according to Argelata in his chapter on the fracture of the cranium is also used by Guido and it has been tested. Recipe: pour six handfuls of *centaurea major* into wine over night. Then boil a measure of the wine until it is consumed. Strain and boil further to a thickness one ounce of honey, two *drachms* of wax, two ounces of woman's milk, one pound of turpentine, three ounces of wax, a half ounce of resin, three *drachms* each of incense, mastic, and gum Arabic. Make a plaster.

Another plaster is made of *betonica* and attributed to Henry of Mondeville. It is tested. Recipe: one pound each of the juices of *betonica*, plantain or *psyllium*, celery strained, three ounces each of resin and new wax, one pound of turpentine. Make a plaster according to art. This has been tested by me.

Another unguent is called grace of God [*gratiola officinalis* or *digitalis minima*]. It has been tested by Leonardo Bertapaglia. It is listed among medicines which generate flesh and is helpful in wounds of the head when required. Recipe: six ounces each of white wax, pine resin, and ammoniac, three ounces of turpentine, an ounce and a half each of *galbanum, olibanum,* mastic, and myrrh, two drachms of *aristolochia* with a decoction of wine, one handful each of verbena, *betonica,* and *consolida major* and *minor, centaurea,* anise, *hypericon,* grace of God, and *bautia.* Make an unguent and knead it with the addition of mother's milk. What the herb grace of God is see above. It is very helpful in the consolidation of a skull fracture.

Useful also is the plaster called apostolic surgical. For its description see Roland in the chapter on skull fracture [caput 7; see Albucasis, *Methodus Medendi,* etc., Basle: H. Petrus, 1541]. [Roland of Parma, *circa* A.D. 1250; he wrote *Rogerina,* an expansion of Roger of Palermo's *Practica Chirurgiae, circa* 1210].

Another plaster is described for skull fracture by the Conciliator. *Differentia* 181. He says it heals by application without moving the bone when the third or fourth day has passed. The recipe is as follows: Doric or malvatic wine [malmsey, a sweet Greek wine] and let *stupes* [pieces of tow] be steeped in it and then wrung out. Then take powders of *psyllium* or plantain and fine white winter wheat ground not too thoroughly. Sprinkle a little over the *stupes* but more wheat than plantain. Some people add some black beans and grain ground up and toasted upon the *stupes* and apply it to the injured area. They use many such *stupes* soaked in wine and then wrung out and leave them in place for three or four days especially in winter. The plaster should draw out the pus from its fermentation in the depths of the body and then consolidate the wound in a more secure manner. The Conciliator says he has seen this method at work and has tested it himself.

He says there is another method more artificial, useful, and common practiced by the Saracens. After the flow of blood has ceased the following unguent which has been tested is applied. Take three ounces of Greek gum, four of pure resin, six of wax, three of rose oil, two of ammoniac, three of turpentine. Make an unguent. I have used it and recommend it.

There is another unguent quite similar highly recommended by Bertapaglia in his chapter on skull fracture. He does not include *opoponax* nor *bdelium.* Recipe: three ounces of Greek gum, two of *opoponax,* half an ounce of *bdelium,* one ounce of pine resin, some white wax and make an unguent.

Another plaster I have tried in contusions of the skull if there is no fracture. Recipe: a handful each of flour, barley, calamint, oregano, camomile, hashish, marjoram, one and one-half handfuls of leaves of *stoechas Arabica* [*Lavendula stoechas,* common lavender], laurel, absinthe.

It does not matter if the leaves are omitted. Use water, oil, and oil of camomile. This plaster has marvellous general effects not repercussive but solvent and comforting.

Bertapaglia has another plaster he rates from personal experience above other medicines for the comfort it provides. Recipe: one handful each of calamint, melilot, camomile, *stoechas Arabica*, flowers of laurel, hashish, *betonica*, honeysuckle, marjoram, *serpillum* (oregano), three ounces of flour and barley, two scruples of crocus. With water, rose oil, and camomile oil make a plaster. I recommend this; it is outstanding when there is no question as to its heat.

I shall postpone some powders and liquors as well as other unguents and my human head wax for discussion when they come up under the topic of manual operation.

Note that Niccolò says that some people tell of their remarkable experience when skull fractures have occurred with pressure and folding inward and damage to the brain material in which the patient loses the ability to speak. Then violets should be crushed and given in wine to drink. Then consider this. If the right part of the cranium is injured bind the crushed violets under the sole of the left foot and if the left part of the cranium is injured place them under the right foot. Immediately the bone will miraculously spring back into place and the patient's speech will return. I do not believe this.

Another method has been discovered first from Spanish sailors as told to me by a person worthy of trust and then from certain Genoese in Italy. Many others have followed it. It involves waters and powders to be described below and can be used with patients of every age, lesion, complexion, and season without any difference. They are allowed to have a robust diet of food and wine. This method is by no means to be despised as far as a local treatment is concerned. It is suitable for simple wounds where a speedy drying out is required and a consolidation that is convenient also in drying out capillary fractures from their humidity also if it penetrates to the membrane. The complexion of the bone and the *dura mater* can allow such a medicine because it is very dry, as Galen says, but such waters should not be administered at the beginning of the treatment nor at a hot season nor with a hot complexion. They can be administered rationally with a diet and drink and manual operation as needed and described below, but such remedies lack a legitimate inventor or author. I totally reject them and would not dare to use them in any way. Those who use this nautical remedy take the water as follows. Recipe: two pounds of water of life (*aqua vitae*), one ounce of myrrh, two ounces of aloes, two scruples of crocus, three *drachms* each of *saracolla* and incense. Some people add grains and four ounces of *hypericon* (St. John's wort). All these are poured together and soaked for six days. Then they are carefully squeezed out and the water used as I shall describe.

Some people sublimate the infusion or distill it through an alembic and then use it when fresh. Others make this water with many other herbs and distill it as an elixir but deceive the people with it so that they can sell their medicines at a higher price. The elixir is as follows.

Recipe: one and half *drachms* each of cloves, aromatic reed, white and red ben nut, aloes, incense, myrrh, cinnamon, *galanga,* musk, mace, red and white roses, *betonica,* camomile, honeysuckle, white and yellow *sandalum,* cardamum, *cubeb, nard,* mastic, fragments of pearls, red coral, holy thistle, white zedoaria [*Kampferia rotunda*], termentilla, bistort, gentian, six *drachms* of fat figs, one scruple and a half of musk and ambergris, nine dates, six ounces of dried raisins, three ounces of honey, six ounces of white sugar, four pounds of water of life. When distilled there first issues a clear water, then it is milky, then turbid. The second distillation is taken and to it are added six *drachms* each of mastic and incense, three and a half ounces of Greek gum, one ounce each of cinnamon, wood aloes, *cubeb,* muscat nut, galanga, one half pound of turpentine. These ingredients are distilled. The first and second waters will be clear, the third reddish. This is used for wounds as they say. I detest and abhor it.

This is the use to which the aforesaid waters are put. These people place as much of them upon the wound as it can retain. Then they fill the wound with this powder: Recipe: two ounces of hepatic aloes, six *drachms* of myrrh, two *drachms* each of *saracolla,* incense, and mastic. Mix and make a powder. Use as above till near the end of the cure. Afterward seal the wound with some consolidating unguent.

Here is another water. Take ten pounds of *aqua vitae,* four pounds of malmsey wine, a pound and a half of incense. Steep together for a month, strain, and use as above.

Another water. Take ten pounds of water of life, four of malmsey, two of ripe grains or seeds of *hypericon* (St. John's wort), half a pound of incense. Steep for a month, strain and use as above.

Another water. Ten pounds of water of life, six of malmsey, four ounces of aloes, two of myrrh, six each of incense and mastic, two pounds of ripe consolidating roots, half a pound of *centaurea,* two pounds of *hypericon* seeds, two pounds of turpentine. Mix for a month, strain and use.

There follows another water. Take six pounds of water of life, two of malmsey, two each of *hypericon* grains and *centaurea,* two ounces each of incense, aloes, myrrh, and mastic. Mix, distill, and use as above. This is the method of such preparations which for the greater part I condemn.

I heartily recommend the liquor described below and use it boldly. I have tested it when the time of the abscess has passed. Recipe: one pound of malmsey wine, an ounce and a half each of aloes, myrrh, *olibanum,* dragon blood. Mix and steep for eight days. Then before all the ingredients have been amalgamated first place two or three drops of rose honey carefully into the bottom of the wound.

Another similar liquor which I use runs as follows. Recipe: one pound of malmsey, one *drachm* each of flour of *orobus* (*ervum ervilia*), fine incense, *aristolochia* root, radish, *opoponax,* myrrh, *sarcocolla,* dragon blood, centaurea. Steep as usual and apply. I recommend this means because wine is allowed in wounds and other lesions of the head. The aforesaid powders are also allowed by Haly, Galen, Avicenna, and others in skull fractures especially when administered at the proper time.

All these should suffice for medicines to be applied externally. I now come to the method of cure used by the first sect, that is, the use of potions.

I say that Niccolò on the authority of Theodoric [of Bologna, 1205-1295 A.D.] says these people cure more boldly with the potions to be described below if they are summoned before any other way or method of medication is attempted, especially in wounds without fresh contusions. In ulcers, however, they are not successful if some other means are tried first. Guy de Chauliac and I hold that such potions are not very suitable in the first days of treatment.

Niccolò sets down some other objections to which I wish to recur. I shall not extend myself in the matter because as I said above I have little faith in these potions. I say, however, that apart from potions any extraneous objects existing in the wound or ulcer such as bones, weapons, thorns, and the like should be removed. The lips of the wound should be kept open as much as possible with a tent or a leaf of cabbage; this will be beneficial together with the strength of the potion. Also if such wounds should be sewed later and covered with a bandage it should be one with retentive or expressive or incarnative effect as the operators know how to apply.

The potion I have seen and used is the following. Recipe: take two handfuls each of the leaves and roots of dyer's madder, long and round *aristolochia* and plantain, *consolida major* and *minor*, cloves, *centaurea major*, one handful each of roots of *althea*, of the tips of leaves of shrubby strawberry, sorrel, *atanacetus*, *millefolium*, anise, *hieracium pilosella* (mouse-ear), *artemisia*, and *cannabis*, one handful each of dyer's madder and strawberry, two ounces of white incense, one ounce of *saracolla*, fifteen quarts of white wine. Place all these into a baked earthen pot whose middle part remains empty, cover it against evaporation and boil for three hours on a moderate fire. Strain and add six pounds of honey and boil again until a quarter part of the whole is consumed. The dose is four ounces every morning and evening, bathing the wound with the potion and placing a cabbage leaf over it. Some distill it and administer three ounces in the morning. I have never distilled it but having made it by the first method I have administered it and seen it used as I said above.

A certain other Jew, a good friend of mine and worthy of trust among the empirics, gave me the following potion which he has used as described. Take a half ounce of dyer's madder root, one ounce each of *cannabis*, white *diptamus*, *betonica*, tops of celery, roots of red peony, leaves of mouse-ear, anise, honey suckle, fever-few (*matricaria*), galingale, *acorus* (iris), cloves, licorice, gentian, strawberry, Venus hair, horse tail, agrimony, *centaurea*, red cabbage, *consolida major*, *aristolochia* root long and round, half an ounce of rhubarb, three *drachms* of *squinanthus* (*Juncus odoratus*, sweet rush), six pounds of honey, eighty pounds of white wine.

Make a potion as above. There are also other potions prescribed by other people which are little recommended as I say by rational physicians.

Among others Guy de Chauliac in his chapter on skull fracture condemns this kind of potion with all his might in these words: "Let not the words of these Theodorics and Genovese be listened to who boast that they can cure every fracture of the head with their mixtures and potions without surgery and the elevation of the bone." Nevertheless, because I promised earlier to describe the mode of cure with potions I shall do so.

Theodoric on skull fracture says: "As has been said above concerning the skin such a bandage should be placed on the head so that the inner vapor may not escape nor the external air enter." This done, let the powder of Hugo be administered in appropriate mixture. Recipe: one ounce of cinnamon, half an ounce of ginger, one *drachm* of *mellago,* one *drachm* each of *galanga, cardamum,* long pepper, twelve cloves, fifteen grains of pepper. Let a powder be prepared. Boil five pounds of white wine and one of honey. A little later add some of the powder to give an aroma to the wine and boil it again to make a pigment. Clarify it by straining. From the total amount take nine small measures and mix with it Hugo's powder which is as follows. Recipe: one leaf each of *hieracium pilosella* (mouse-ear), saxifrage, *caryophyllata aquatica,* gentian, valerian, leaves and roots of gentian but only mouse-ear root. Let as much as from all the rest be taken of the latter. Make a powder. Take three fingers full of it and make a pigment and add it to each measure. Then make the sign of the cross in the sign of the Father, the Son, and the Holy Spirit and of the undivided Trinity. Say the prayer: "The right hand of the Lord has exalted me. I shall not die but I shall live and shall tell the deeds of the Lord" [cf. Pietro d'Argelata, op. cit., ed. 1450, f. 56, for the same prayer]. Let the aforesaid powder be applied after the prayer so that it may liberate the patient. The method of application of the powder is as follows. At the first visit of the physician when the patient has begun to eat and wishes to drink while eating give him one measure of the mixture along with the sign of the cross. At midday between lunch and dinner give him another measure, at dinner another and if he keeps it down without vomiting his head is consolidated; if he vomits it will not be consolidated. If there is a tumor make similar poultices for the wound.

Recipe: with mallow leaves cooked in wine and bran make a plaster and place it on the head with a *stupe,* changing it each day. Theodoric, however, says that if the patient vomits this is a very bad sign and he despairs of the plaster's effect and recites other idle stories in which I have little faith. A decoction of *stoechas* alone is much praised and in *Continens* XV *mumia* given in a potion is greatly recommended for fractures.

Niccolò lists another potion and says it is good for wounds, healing them in nine days. It does not, however, remove lethal objects and expel bones. Recipe: one leaf each of red cabbage, fennel, parsley, *abrotanum, atanacetum,* strawberry, dyer's madder, robert herb, plantain, *arnoglossum, cannabis,* celery, muscat nut. Boil in wine with honey. Drink morning and evening and bathe the wound externally with it. Place a leaf of red cabbage on the wound and proceed in this manner.

There are many other potions described by others also by the ancients. John Mesue junior has one for healing wounds which I shall postpone lest I bore my readers.

Chapter XV

On the Cure of Lesions of the Membrane and the Brain With Medicines

But since the subject of the lesion of the *dura* and *pia mater* as well as of the medullar substance of the brain has not been treated on any method of cure by any author in writing and in order that my book may be more complete and useful it appears to me that something must be said concerning wounds of the aforesaid members especially since some times as I said before such wounds have come under my hands which with the help of divine guidance have been brought to a fortunate end.

I say therefore if the wound happens to be in the aforesaid members beyond all other care the physician ought with all his skill to prevent all strong movement of mind and body in his patient nor should any but the very slightest agitation be made by the physician with any instrument nor in wiping, bathing, and medicating the wound, as will be said.

Nor should any pus retained in the lips of the wound be wiped away manually but only with some lotion from those described below since by violent touch and agitation in so noble and soft a member as the brain and the *pia* membrane pain will result and perhaps a new break of continuity by which a large passage of exit may be created for the *medulla* and thus death. But if it is not touched except in the manner suggested nature brings aid to the area of the injury and the wound is consolidated. Hence in this way a light touch should be maintained until the fourteenth day has passed. Then the physician can handle the wound more boldly or confidently but nonetheless always gently.

From the beginning when the flow of blood has been checked with egg and other suitable means let woman's milk freshly drawn from the breast be poured into the wound and the wound washed with it twice or thrice at every change of dressing. Let the milk be warm when used or the wound should be washed with malmsey wine in which red roses have been boiled. Then fill the bottom of the wound with lint one or more times according to the size of the wound which has been dipped in the milk and then fill the rest of the wound with lint soaked in rose oil. Then place two or three pieces of linen one palm in breadth also soaked in oil upon the wound. Then bind the head with the appropriate bandages, *stupe*, and cloths.

Let this method of cure proceed for four to six days and no further. Then take some head unguent from among those described and put it on the lint or on cotton and soak either one in rose oil and honey in equal parts, thus filling the wound with it. A large amount of the unguent should be placed on the wound, first anointing the entire head with oil.

The unguent I use and approve in these cases called the honey suckle unguent I shall describe herewith. When I use my human wax and some other remedies I wash the injured part when the ninth or tenth day has passed with woman's milk three or four times. Then I use the aforesaid unguent as above on the area not washed because then a warmer medicine is required and proceed thus. Then I remove the rose oil gradually and add some honey until about the fourteenth day I use rose honey alone. Next, with lotions, powders, and my wax I replace the flesh above the wound, washing it if necessary with a sponge in embrocation or with a syringe, gently impelling the preparations toward the bottom of the wound when the ulcer is formed so that the pus may be dried out which sometimes is so great that physicians doubt whether it can be dried out. For this drying out they resort to the cure of deep ulcers which are called caverns and sinuses (*absconsiones*) by Avicenna, *Canon* IV, fen 4, in which finally a consolidation of flesh takes place to completion.

But since good fresh rose oil is not to be found I take myrtle oil and rose oil in equal parts and use them with good success.

On the Cure With Medicines of a Contusion Caused By a *Ballista* or What Is Called a Musket

Young men should also realize that sometimes the head is struck by some bullet or ball fired by a musket or a similar weapon and a contusion due to the sulphur, niter, and fire accompanying the shot is caused, involving an inflammation and sometimes the formation of an eschar or scab. This contusion should be handled like other contusions as far as manual operation is concerned. Local medicines applied should be such as are suitable both to a contusion and to a burn caused by fire. Among other medicines I often use rose oil alone; it is excellent for promoting the drying out of the wound when needed. The following recipe is helpful. Recipe: eight ounces of rose oil, two ounces of oil of yolk of eggs, two ounces of very white glass powdered very fine, one and one-half ounces of white wax, one handful of the inner bark of the *sambucus* bush. Boil them all together according to art, strain, and you will have an unguent without equal for use from the beginning of the treatment until the wound becomes filled with flesh. Thereupon the wound will heal like others. The unguent is marvellous for all burns.

In these contusions this unguent is to be used alone until the hot bad quality of the wound is removed, then treat as other wounds. I could list many other remedies, but I wish physicians would turn to the chapter on fire combustion and contusion and prepare a cure appropriate in their judgment to the lesions involved. This is easy for a legitimate physician.

Why a Stronger Medicine Is Required for Internal Wounds and Abscesses of the Head and What Is Meant By a Strong Medicine

It remains for us to resolve a doubt concerning the meaning of Galen's remarks in *De Ingenio Sanitatis* IV, chapter 7, and of Avicenna's in *Canon* III, fen 1, tractate 3, chapter 11, that is, that stronger medicines are required for internal wounds and abscesses of the head than for external wounds.

This is the solution of the doubt. The medicine which must penetrate within must be strong so that its power is not diminished on the way and especially in an abscess or wound where the skin is thick as well as the pericranium, cranium, and other membranes. But where a wound requires a strong medicine this is because those members are solid and hard except for the *medulla* of the brain and by far more dry than the exterior members. Likewise, in external wounds less pus collects than in internal ones because of their size and depth. In order that members should be preserved in their complexion and a greater quantity of pus should be dried out a stronger and more powerful medicine is required.

Of two modes or means one is said to be weak, the other strong, the first because its substance is thin so that its strength is easily diminished just as in the rose and the camomile and such like. The second reason for this distinction is the qualities of each. Medicines of the first grade or temper are said to be gentle. Medicines of other grades are said to be strong whether made from minerals, plants, or animals more or less according to their substance. This is what Galen meant in *De Ingenio Sanitatis* IV, chapter 6, at the end, when he said it is no wonder if the hard membrane perhaps does not escape medicament when the bones are moved aside, that is, is very dry if it does not have a large abscess since its substance is very dry.

There are, however, many medicines listed by me above in the cure of external wounds which are suitable as well for internal lesions when the quality of the wound is considered as well as the diversity of complexions of the head. I leave these considerations to the skilled and expert physician.

Let the physicians note, however, that for internal wounds with the medullar substance of the brain injured insofar as they are wounds a very strong medicine is not suitable in drying out by reason of its complexion as it is suitable for the injured membranes alone. Hence let the physicians with all their skill turn their attention to this if they are legitimate and guided by experience, as has been said many times concerning the opinion of Avicenna. They will then find the precise step to follow in administering medicine. Thus with the help of God I have said what pertains to the second instrument of medicine, to which I now place an end.

Chapter XVI

The Cure of Cranial Fracture By Surgical Instrument

I begin a chapter which is in medicine difficult, great, and almost horrendous, that is, manual operation, the ultimate instrument of medicine. With the guidance of the Parent of all things I shall contribute not a few instructions useful to my successors, treating solely the cure of lesions of the head with cranial fracture and showing the method of operation for each kind of injury.

Come then, come, come, O Holy Spirit, and illumine no less my mind than that of those who hear me so that what I say concerning the moving aside, the incision, and the elevation of the bone may be said well and understood clearly since there is no greater danger among the instruments of medicine than in this especially if it is handled unskillfully. If, however, the operation is carried out as required in the appropriate manner and at the right time those who are already on their way to Tartarus can be recalled. In my words will be found no frivolity nor boasting such as the Genovese [Giovanni da Vigo and his pupil, Mariano Santo?] employ nor of any others who depart from the true Hippocratic path.

Concerning the Time When the Bone Must Be Moved

But before we turn to any particular operation we must first see at what time such a cranial operation should be carried out since it must be done quickly in some cases and without delay or sometimes later as the symptoms may indicate. While we find that much is said by the ancient authors about the time to be selected for moving the bone as we shall demonstrate there are nonetheless some who say that the physician cannot know this time exactly. An opposite opinion is voiced by Galen, Paul of Aegina, Oribasius, Haly, and some others. I am also of their opinion because that time can be precisely determined especially by distinguishing the kind of broken continuity involved with its differences, which are in part as follows.

That kind which is called *empyasma, antiaca,* and the one called *marusis* or *monesis* are those in which the bone punctures or weighs heavily upon the membrane of the head and is known by the signs which have been described earlier [see chapter I and Haly, *Pantegni*]. I say the bones must absolutely be moved at the first hour or a little later. There is also the kind called *rhagamia, darca,* or capillary [hair line] fracture penetrating inward and existing in a body of bad chyme and a patient who does not cooperate with the assigned regimen. Although no serious symptom may appear we say the bone must be moved absolutely and the sooner the better. With the same kind of wound even in a clean strong body and an obedient patient I say we can ascertain the time exactly when symptoms are to be expected which for the most part occur in winter before or near the fourteenth day and in summer before the seventh. It is therefore established that the time for moving the bone can be accurately ascertained. In other forms of wounds it can also be recognized as aforesaid. The physician should labor with all his might to recognize the differences among these kinds of lesions and to understand whether an incision must be made and how and when.

Among others there are two principal factors which create the necessity for moving the bone, both repulsive and extraneous in nature, first, when the bones press upon and puncture or when foreign objects do this, such as spear heads, pieces of wood, arrows, bullets, iron, or bits of other things. Second, when the pus does not have free exit. Thus the discussion centers upon these two factors, which we can treat better by surgery.

First, I say that on the authority of Oribasius as contained in *Continens* XV, chapter 3, at the end, it is possible to anticipate the time exactly for moving the bone in whatever kind of situation. He says: "The bones should be sawed at the time the fracture occurs whenever they puncture according to the advice of the surgeons. Unless they puncture let a delay of three days more or less take place according to some, so that the pus may collect and the cranium may be separated from the *dura mater*. Some people see that a delay must be made during which no *paracentesis* (*punctio*) or tapping takes place for fear of harm due to pus dripping into and injuring the brain, etc."

Certainly from the words of Oribasius the time for moving the bone can be accurately chosen in whatever injury described for not only he but some others agree that the bones which are puncturing should be removed at once. Not all of the bone needs to be removed, according to Galen at least, but only the more significant agent of the puncture, for puncture is what causes this operation to be speeded up. If this cannot be done at the first hour it should be done at least on the first day. This is what Galen apparently says in *Continens* XV, as follows: "Where the puncture and infestation have occurred on the bone in the first hour of the injury or on the first day unless it is cut out entirely that part of it which is particularly causing the puncture should be removed."

Avicenna concurs in his chapter on skull fracture where he says: "When the necessity is verified for extending the wound and cutting into and extracting the bone then haste must be made and no delay in awaiting the completion of the pus in the wound should take place. This is to be understood particularly when the *dura mater* is compressed or punctured since such a puncture will cause an abscess or a spasm, perhaps leading to apoplexy. The bone should be extracted at once and sensation will return to the patient if apoplexy has set in."

You see, reader, on what authority the bones which puncture should be extracted at once, and you have seen the reason why here and elsewhere. But if the bones are not puncturing there is no need for haste. This should be understood not only of a puncturing bone but of other extraneous objects as well.

There are some cases in which we ought not to postpone operation until the second or third day, such as if the perforation is manifest or the incision is of such a nature and in such a body where pus would necessarily collect in the depths of the wound and there is not a sufficiently large orifice in the bone to allow for needed cleansing so that the pus may be purged and the medicines can be introduced. But since in the aforesaid case pus generally begins to be generated on the third or at least on the fourth day a way must be made for its exit lest bad symptoms occur. Therefore some people insist that the moving of the bone should be carried out on the second or third day. Hence Rhazes above I believe also on Galen's authority says: "What must be sawed from the cranium should be sawed speedily without delay before rust (*erugo*, i.e., pus) descends to the *mater* of the brain as they used to do when awaiting the completion of the putridity and the *dura mater* or little *mater* to separate from the cervix. Hence this must be done with care and the fact ascertained if the *dura mater* is not punctured by some broken bone. But if it is punctured one cannot and ought not to await the formation of pus. However, if no danger exists from the aforesaid condition one can wait a moderate length of time just so that one does not wait until the third day. Most of the time the operation should be carried out on the second day."

Note, reader, that I declared above that I believe the authority adduced in *Continens* XV to be Galen. I said this because I believe Galen wrote another chapter which we lack at the end of the sixth book of *De Ingenio Sanitatis* since in fact he begins to talk of skull fracture in the sixth chapter and in my opinion did not complete the method of cure of head wounds. Therefore I believe that the seventh chapter of this book is missing and especially since Rhazes, above, adduces the authority of Galen in the seventh chapter of the sixth book although Rhazes does not give the subtitle of the sixth book. I say this especially because I see Galen's followers, Paul of Aegina and Oribasius, discuss fully the cure of head lesion with cranial fracture and since I see Galen adduced as authority by Rhazes, above. He among others was a searcher after the cause and effects of medicine. In conclusion, I judge that we do not have the complete sixth book of Galen's *De Ingenio Sanitatis* [*Methodus Medendi*].

There are furthermore some cases in which we can wait beyond the third day, in fact, as far as the seventh day in summer and the fourteenth day in winter and even beyond, according to some people. These cases are those in which we are not certain of the rust, that is, the pus collecting on the membranes. The beginnings of symptoms coming from the pus show that the time can be precisely known since certainly pus cannot remain in so noble a place as that between the cranium and the *dura mater* because it creates some bad concomitants, such as fever, rigor, confusion of mind, and such like especially because it is shut up there without evacuation. When physicians see the first beginnings of such symptoms they ought to hasten the moving aside of the bone so that the pus can be purged from that place. If the symptoms are confirmed the treatment is to be abandoned, as Haly says, because the patient is on his way to death.

Galen says so too: "If symptoms supervene and persevere the treatment should be abandoned."

When the bone does not puncture nor weigh heavily and when the *dura mater* is not deeply incised such symptoms do not occur except from pus retained as was said above between the cranium and the *dura mater*. Therefore authors say the exact time for the incision and the moving of the bone occurs when the *dura mater* is separated from the cranium. And they say this prudently because if such an operation required to move the bone aside were carried out while the *dura mater* was still attached to the cranium there would be great danger from the incision. In fact, it would be impossible not to injure the *dura mater* given its strong attachment to the cranium throughout its extent. I hold to this view as described perhaps more than other contemporary physicians.

The physician who is ready to operate on the bone ought therefore to recognize the time of separation of the membrane from the cranium because otherwise he can bring about death for his patients. The time of separation occurs when the symptoms I have described many times are present. At that time the bone must be moved when the symptoms occur for the reason given because at the time when the membrane is separated from the cranium pus collects in the area and must be removed.

Let readers note that the *dura mater* is separated to a small distance around the lesion especially in those who are healed because if it were entirely separated beyond the sutures, as many hold, few patients would be healed since the pus could not be dried out at such a distance, that is, between sutures and would continually seek the lower region of the vacuity. All those injured with a penetrating fracture of the cranium would have to die. Therefore let those who are opposed to my words acquiesce in them, make sure of the facts by a good anatomical dissection, and trust not only in the authorities but in experience.

That this is true, namely, when the *dura mater* separated the bone must be moved is proven by the authority of Oribasius in the aforesaid passage. He adds these words: "Unless there is a puncture you should wait three days more or less so that the pus may collect and the cranium be separated from the *dura mater*." He also says: "Some people see that there must be a delay in which no *paracentesis* (*punctio*) is made because of the possibility of harm from the pus dripping onto the brain." Oribasius suggests here that when we are in doubt whether an opening in the skull ought to be made or not we should await the damage from the pus which is recognizable from the symptoms, implying that the symptoms are those which show the *dura mater* is separated and then the bone must be incised.

That such an incision ought not to be made unless the *dura mater* is separated is shown in *Continens* XV where on the authority of Paul of Aegina he says: "Significant signs are required as to the separation of the membranes. Unless these signs appear the membranes are intact." By this Paul means that no operation is required. The time of the collection of pus if it is going to collect as well as that of the separation of the membrane is generally placed by authors in summer before the seventh day, in winter before the fourteenth.

Note, reader, that when a physician of some competence can recognize that the moving of the bone is necessary for the reasons described an incision should be made as soon as possible without waiting for symptoms nor for the seventh or fourteenth days. Note also that the aforesaid authority of Paul is adduced on the authority of Galen. But that it is that of Paul is clear to any reader. I believe the error is that of Niccolò's printer.

Note also that Haly agrees on the time with Paul in *Practica* IX, chapter on skull fracture. He says: "If the membrane is separated and the wound occurs to the patient in winter the parts of bones must be removed entirely before the fourteenth day. If it happens in summer then before the seventh day before the symptoms we mention occur."

Abulcasis agrees with these authorities in his *Chirurgia* III, chapter 3. He says: "If you see symptoms which are not serious, that is, not very strong at the beginning when the pus begins to be ebullient under the cranium and you hope to save the patient then begin his treatment as soon as he arrives in his wounded condition. Remove the bone before the fourteenth day according to all factors involved. If it is summer act quickly before the seventh day before the formation of pus sets in under the bone from the membrane and bad symptoms ensue." The reason given for greater haste in summer than in winter according to Dino, Niccolò, and others is the swifter ebullience of the pus in summer. Putrefaction takes place more slowly in winter.

Avicenna, however, seems to disagree with them concerning the time when he says: "There should be no delay in summer beyond the seventh day, in winter beyond the tenth, the sooner the better to avoid great harm."

There are some who say that Avicenna's statement about the tenth day causes them to think that his text is corrupt and badly translated. This makes little difference since elsewhere he says the sooner the better. I am surprised nevertheless that Galen says above we can await the formation of pus in a more leisurely way just so that it does not last beyond the third day but he also says the majority of cases ought to be cured on the second day. Certainly the time allotted by Galen is brief. However, I believe that he has in mind a large fracture because of which the physician recognizes that other conditions prevailing he cannot wait any longer to operate. This difference of opinion among the authors mentioned in hastening the operation is readily recognized by a good physician.

Note, reader, however, I believe that other factors beside those mentioned are involved such as the time of year or season, age of the patient, region, complexion, his condition of humors, and such like. I believe such factors apply to a young man and even more slowly according to his bodily disposition than in an old man if they are to occur at all, more swiftly in a hot and humid complexion than in another. The causes are well known. Hence we must give thought to the region, as Paul of Aegina said, where the operation is to be performed; he, of course, referred to his own region. Perhaps Avicenna said the tenth, not the fourteenth day because his own region was very hot. Hence from what has been said one can judge where it is because symptoms arise more swiftly in one region than in another although the conditions of the lesion contribute greatly to this acceleration since a large lesion occasions symptoms swiftly. If the wound is slight the symptoms are slow in coming and moderate. Given a parity in the lesion these lesions are speeded up or slowed down by the causes stated earlier.

It is no wonder then if sometimes the fifteenth day can pass before the operation on the bone is performed, according to Maffeo de Laude in his *Quaestio de Fractura Cranei* or Research on Skull Fracture. He moved the bone after the fifteenth day for a certain count in order to purge the pus in his head and he was cured.

Niccolò speaks to this question: "Certainly we must realize that an incision of the bone ought not to be made unless it is necessary. This necessity is determined by the advent of certain bad symptoms. When these are perceived the physician must operate immediately. This is in truth the method of procedure."

Note, reader that sometimes the aforesaid symptoms occur and the bone is not incised but the patient recovers all the same. I myself was forced to witness such a case. Almost against my will I was attending at Bologna a certain Martin, a messenger of the customs service, who had been severely wounded in the head with a sword. His fracture was almost a hair-line, larger however, and running inward without lesion of the membrane. Around the tenth day I saw symptoms indicating separation of the membrane. Immediately I desired to cut the bone and widen the fissure but my patient did not consent to the operation. Nevertheless, I proceeded in the treatment with medicines which attract the pus. Through the little crack a notable quantity of pus continued to issue forth while I ordered him to expel air from his chest to his head and thus by puffing a considerable amount of pus came out. However, he continued to suffer from fevers, rigors, and extreme uneasiness almost until the fiftieth day. Finally, nature herself separated the entire bone of the head from the *dura mater* as far as the surface of the bone to the extent of a small aperture. Thus the *dura mater* became covered with flesh and he was cured. It is true he was young and of a strong complexion. I have related this case to show what nature can do even without a regular treatment, and I saw this situation in other patients with whom the use of proper medicines, that is, those with the power to attract pus, were used and they were healed, especially since the constitution of these patients was strong.

From what has been said therefore about this instrument of medicine as well as elsewhere above you can recognize the time of opening the skull and moving the bone. Nonetheless, I say with Niccolò that the bone should not be moved unless it is necessary because often some patients are healed without such an operation by means of the appropriate medicines when the physician did not expect them to recover. This has been verified many times by me and also among other practitioners.

How the moving of the bone ought to be carried out I shall explain in detail and according to the different forms of injury which require a different approach to the operation and I shall demonstrate the ingenious and quite safe instruments used.

Before I do this, however, I shall describe some medicaments which I have tested. You should not expect a great number of them from me but one only, my wax and one other unguent with some powders and certain liquors and lotions which I have always used. Although I have tried many others I now use only one of them nor am I converted to the use of other medicines, following the injunction of John of Damascus in his *Aphorisms* [Serapion senior, often referred to as John of Damascus; 870-930 A.D.]. He says: "Hold on to those which are available and to which all people turn and especially to those you have tried out. Avoid those which are doubtful and about which people disagree. Certainly no rational physician can object to the medicines listed below if they are administered in their proper time as they should be."

He also says that you should cling to only a few medicaments unless you have rather frequently experienced the aid given by other medicines. It is impossible to have a knowledge of a multitude of them, for when you may wish to inquire into and to discuss them one by one you will be distracted by their great diversity of properties and will be able to place your trust in none of them. The property of medicines is dubious for many who have once experienced it have decided that what they accomplished with it was due to that special property when in fact nature often was the source of their success. Avicenna also in *Canon* II and V in the beginning says you should know that a medicine you have tried is better than one you have not tried and a little medicine is better than an abundance of them for one purpose. Haly also in the second discussion of the second part of his book says it is safer to use what has been already discovered as a medicine rather than to try some thing new for medicaments present a peril to men's bodies and among perils a common and more probable path should be followed. Moved by these words I content myself with few medicines. I have nonetheless listed many remedies above according to the opinion of experienced authors. Those which I have tried I have spoken of in detail so that if one does not help another can be employed. Thus my book will be more useful and acceptable.

But also before I proceed further I must say something of the area in the head where one must operate more safely. Then I shall say how much of the bone must be moved. Next it is fitting to examine whether the medicine is dry or humid. After that I shall list in detail certain medicines which I have described in part already.

Concerning the Place From Which the Bones Are to Be Moved

As Niccolò says concerning the place to be selected for opening the cranium and moving the bone authors point out three purposes which determine that place. First is the site which must be in a lower area so that superfluities may be more easily drained away from it. The second is the quality of the bone, whether too thick or too hard, for although the site may be favorable thickness and hardness may be unfavorable factors in the process. Therefore Galen said in *De Ingenio Sanitatis* IV: "I know since I saw some one whose head was fractured and whose temporal bone was injured. Ignoring the latter bone I cut into the bone which was in the cranium and the patient was restored to health and is still alive. If I postponed cutting into the cranium the membranes under it would necessarily putrefy before the bone would be healed because unless I know that the pus would descend from the upper part to the lower the incision of the bone would not be helpful."

He says furthermore: "I saw another man with a wound in the head like that of the previous man. I decided to ignore the upper bone and cut the one near it so that the pus could flow out. When I considered the thickness and hardness of this bone I saw it was more useful to cut the upper bone than to be concerned with the pus since I feared the brain would be damaged. Likewise I remembered that if a broad foramen were made in the bones which exist at the sides (the temporal bones) the cause of harm to the brain would descend and pass outward."

Guido [Guy de Chauliac] cites this test of Galen and says in other words: "I finally saw that the *bregma* bone was fractured. Below it is the temporal bone where occurs the suture which unites the squamous portion of the temporal bone to the parietal bone. It had a very large fissure. I did not touch it at all but only cut away the *bregma*. I cured the man and he has been alive for many years. If I had left the *bregma* as it was the membrane beneath it would have putrefied before the fracture became porous."

Note, reader, that the first text of Galen is obscure but the second text is clear and lucid as adduced by Guido. Nevertheless, he says the same thing and the two authorities have the same opinion. Galen says therein that he had a certain case in whom the cranium was fractured as well as the temporal bone, that is, the head was fractured in two places as Guido's text says in the top of the head where the two bones of the *bregma* are which physicians call the bones of the cranium and especially Avicenna, *Canon* I, fen 1, chapter on cranial anatomy. The head was fractured also in the temporal bones and Galen in operating incised only the cranium but not the lower part. The reason he gave was that in the temples there was a large fissure as Guido's text says from which pus was flowing freely but it could not issue so freely from the top of the head as from the sides. If it collected at the vertex it would damage the brain. This area is not adapted for purging as is the area of the temples. And thus he was healed.

There is another similar case in which Galen wished to open the lower part but realizing that the bone was hard and thick at the temples he was uncertain whether the brain might be damaged as well as of the exit of its substance if a large aperture were made there together with lesion of the nerves which issue from that place. He opened the head again in the upper part, that is, the *bregma* and this patient was cured. Therefore the quality of the bones and the nerves issuing from the cranium vary the location of the incision to be made.

Note, however, reader, that the places from which the nerves issue forth from the bone of the head are very deep. Note also that those temporal bones in some parts are not very thick. They are much harder than the bones of the cranium.

But if there were a case in which only the temporal bone was injured I would not be bold enough to perforate the cranium, that is, the *bregma* because I cannot conceive of a way by which the pus could ascend to a height so remote and so much the more with pus lying between the *dura mater* and the temporal bone because pus always collects in the place of the injury. This is because it cannot ascend to the *bregma* for the reason that between the temporal and *bregma* bones the *dura mater* is attached in some part of the cranium and could thus mediate the ascent of the pus.

It would also be cruel to open the head at such a distance from the first lesion, that is, from the vertex to the temples or thereabouts. Although Galen says he did not open the head in the temples because of their hardness and thickness and because of the nerves which issue forth there and possible danger to the brain I, however, would boldly open the temporal bone if it is injured rather than the *bregma* where there is no lesion, proceeding carefully, making a suitable aperture, and then placing the patient in such a position on the bed with his head arranged so that the pus would issue forth but not the substance of the brain. I would avoid the location of the nerves and look for the spot in which the bone is thinner, operating with good safe instruments which would be less dangerous, observing in the process the aforesaid examples which are badly understood by many.

Some say the greatest danger is to operate in the place or near the place where the sutures are or where many nerves issue forth as well as arteries and veins, as Avicenna says in *Canon* I, fen 1. In fact, if the fissure is continuous with a suture or is near it they say the moving of the healthy bone contiguous with an injured bone should be made from the suture.

Note, reader, that although arteries and veins and nerves are found between the sutures it is not on this account that the physician should always avoid the sutures in operating for some cases can be found in which it is necessary to move the bone in the suture, that is, elsewhere if it happens that the head is injured severely in the place of the suture either because immediately or in time the *dura mater* happens to be separated at that point. Then operating in the suture will do no harm to the veins and arteries because they are now separated and distant from the cranium.

I have conducted this operation many times nor have I found any difference from the operation as made in other areas. It should be conducted in such a way as to be successful. It is prudent to take everything into consideration but one must operate in an area which will be well purged.

Concerning the Quantity of Bone To Be Moved

Avicenna discusses the quantity of bone to be moved in his chapter on skull fracture on the authority of Hippocrates and Galen. Galen says one thing and Paul of Aegina another. Galen says you should not cut from the bone anything but the injured portion for that part which has been violently crushed ought to be removed entirely. But in the case of that bone from which fissures extend for a great distance it is not necessary to pursue the fissures to the end. No harm will result from this cause when in the rest of the operation the proper method is followed.

Galen has this opinion also in *De Ingenio Sanitatis* VI, chapter 6, where he says: "But if the entire bone is fractured it is necessary to remove it all until you reach the uninjured part, but if it is not fractured or contused throughout it does not need to be removed in its entirety. Only that part you know to be harmful and which cannot remain should be removed. I have done this many times and have made no mistake."

Note that this quantity of bone is measured by an expert according to the quantity and quality of pus contained in it because where there is a lesser quantity of pus a smaller passage is required for its purgation. If it is a large amount or if there is little pus it requires an exit of corresponding size.

The quantity of bone to be removed should also be measured according to the quantity of altered membrane involved so that the latter can be wiped and cleaned during the operation and then medicated as well. It should also be measured according to the size of the object to be extracted. The location of the wound should also be considered in the operation because at the vertex of the head a larger part of the bone is to be moved than in front, behind or at the sides of the head. The site of the wound is helpful in purging the pus. Likewise, in the lower part of the head a great quantity of bone should not be moved aside lest the brain issue forth and also lest from a large opening the nerves which are more numerous at the sides and the back of the head than elsewhere should burst forth.

Hence Niccolò says there is very great danger in removing the bone in the posterior part of the head as some say especially when they say they never saw or heard of anyone who survived in whom the bone in the posterior part had been moved.

Nevertheless, I say I have sometimes seen the opposite result. Among these cases was master Paolo of Hungary [the nephew of the Cardinal Bakócs] whom I mentioned above as an example of incision of the brain who among other wounds had a large one in the lower posterior part of the head toward the neck from which at my first visit to him I removed a sizable part of the bone and he finally survived.

It is also well known, illustrious prince, that I removed with instruments a sufficient quantity of bone in the posterior part of your head and you recovered splendidly. I have seen some others who also survived. Let this be enough discussion of the quantity and the place of removal of the bone.

Concerning the Quality or Property of the Medicine To Be Applied to the Head

Having examined the time, place, and quantity of bone to be moved we must turn to the medicine which should be applied at that time and even before. There seems to be a doubt on the matter expressed by Galen, *De Ingenio Sanitatis* (Vol. X K. 454-455), at the end of Book VI as to the choice of medicines, whether they should be of dry or humid complexion: "Having said what had to be said concerning these matters it remains to discuss medicines for the head and the procedure after the incision. I say that when the incision has been completed a medicine to reduce pain should be given as physicians of our day have done many times, or something opposed to this such as a very dry medicine which Meges (*methos*) always praised and a certain old man in our city was accustomed to place on the membranes which lie under the cranium and which he had denuded from the bone. He immediately placed on it an unguent called *isis* (*ethisios*, filtration; Galen 11.126). Upon this unguent he placed a mixture of honey and vinegar. The old man was faithful to this medicine nor have I been bold enough to use it. I will be his witness before God since more have been healed by him in Asia with it than by those who used a soothing medicine. Therefore I wished to test it while I was in Asia. But now since I am in Rome I have laid it aside and have followed the Roman surgeons.

"But when I inquired into the essential nature of things I remembered something I had proved by experience. I say therefore that the foramen of the ears to which hearing penetrates ascends not only to the *dura mater* but to the nerves which bring hearing to the ears. Hence since that foramen is near to that membrane and to the nerve which originates from the brain so we say it is no wonder if the *dura mater* when perchance the bones are removed and if the membrane does not have a large abscess in it tolerates medicine."

Alexander the physician [Alexander of Tralles, 525-608 A.D.] also commends the old man with his dry medicine, as Jacques Despars says.

It is written also in the *Megategni* [i.e., *Methodus Medendi*] VI, last chapter on skull fracture that drying medicines which create flesh are to be applied quickly and medicines which soothe and putrefy such as wax and oil and the like are to be avoided. Unless we do this we are not sure that very serious and harmful symptoms will not arise. The bones to be expelled should be extracted with great caution and apprehension.

The text above adduced by Jacques Despars is not in our *Megategni,* but a dry medicine is also recommended in our text.

Therefore we must come to the resolution of such a doubt since also some are found who proceed alone with the incision and moving aside of the bone and the use of rose oil, as appears from Rhazes, *Continens* XV, on the authority of Paul of Aegina, who says: "Place a cloth soaked in rose oil and wine upon the membrane." Serapio also on the cure of headache from percussion says: "If the hard membrane is laid bare we shall pour tepid rose oil on it. If it is not laid bare we add a little vinegar to the oil." Avicenna also in his chapter on skull fracture says: "After the operation with instrument you should lay a linen cloth over the mouth of the wound and soak it with rose oil. Then take another cloth folded in two or three, soak it in wine and rose oil and smear the entire wound with rose oil." He also orders a light bandage, a regimen against inflammation, and other similar means. He bids that a scab should be formed. Abulcasis says the same thing.

Having examined these contrasting opinions we must see to which of them we must adhere in detail. Galen holds that a medicine which dries out the wound is more suitable in lesions which penetrate the head as was said by him above and reinforced by his experiences in Asia as well as by reason of the dry complexion of the member. Alexander and the author of the *Megategni* say the same thing. We say also that the *dura mater* is full of nerves but in the wound when the nerves are exposed we should wait in order to prevent an abscess and never put rose oil into the wound since it causes putrefaction. So we say that rose oil ought not to be placed on the *dura mater*.

Serapio, Paul of Aegina, Avicenna, and many others hold an opposite view. That is, they say it is better to begin after the laying bare of the bone in all wounds which penetrate the cranium with a medicine which reduces pain, that is, with rose oil rather than with a medicine which is quite drying in its effect, as Galen also says in *De Ingenio Sanitatis* III, chapter 8 (Vol. X K. 211-214) in order first to obviate symptoms such as an abscess and to preserve the complexion of the member. But since in all wounds of the head and immediately after the bone is moved the humors begin to run, especially the hot ones, to the site of the wound therefore one must proceed with means which are cooling in their effect and somewhat styptic, such as rose oil.

Avicenna, *Canon* I, fen 4, last chapter, says that when two illnesses are combined or there is a suspicion that they may be combined we should begin the cure of the one more serious since without its cure the other illness cannot be cured. But since there is a tendency toward an abscess of the membrane spasm and such symptoms are more troublesome than the wound itself. Hence after a bone has been revealed and also without its elevation it is better to administer a sedative drug and such medicines as will work on the abscess, especially as long as such symptoms have not occurred. Afterward administer drugs which dry out the wound thoroughly so as to form a scab and to consolidate the wound.

Pay attention, operator, that although it may be safer to begin after moving the bone with rose oil on account of the aforesaid reasons nevertheless in the administration with oil it should be removed as quickly as possible because insofar as the wound is a wound it is not suitable nor convenient for the complexion of the member. Its excessive use leads to putrefaction and in this matter many physicians go astray although the learned ones generally recommend its use for three days or a little longer. But they are beginning to mix rose honey and wine with the oil and some drying medicine as well more or less according to the symptoms perceived. Hence many insist that Galen meant to say this in *De Ingenio Sanitatis* VI and so do Alexander and the author of *Megategni*.

As to what has been said about not putting rose oil on wounds of the nerves given that there is doubt concerning the formation of an abscess it must be said that although the membrane is full of nerves it is not completely joined with a nerve and in a wound of the nerve there is not so much agitation of the humors as in a head wound because of the disturbance caused by the moving of the bone. Hence the use of rose oil is more suitable in the head in order to cause repercussion and comfort. In a wound of the nerve there is another drawback, that is, pus is much imbibed or will be imbibed in the nerve. Thus if rose oil is used on it putrefaction of the pus will set in and damage the nerve. But the membrane is thin and thus able to receive little pus in comparison to the nerve. Therefore rose oil is suitable on the head, but not in other members where there are nerves. Hence it appears that at the beginning of the treatment rose oil is suitable but at the end a drying medicine is better. In this way a response seems to have been made to objections.

It is true that rose oil should not always be applied after the moving aside of the bone but only occasionally. Now and then also a drying or abstersive medicine should be used as the condition of the wound requires. Sometimes the physician cuts the bone and moves it aside to find there is a healthy membrane notably unaltered beneath it. Then he proceeds with rose oil, as was said above. But now and then he finds the membrane altered and ready for putridity. Then to apply rose oil on the membrane would be counterproductive because corruption and putrefaction would be increased. Then one must proceed with means which will both cleanse and hinder putrefaction; these means are of a dry complexion. Hence one must not always proceed with a sedative medicine.

If it happens that due to the disturbance of the head and the pain caused by the extraction of the bone the humors run to the wound we divert them by another path with a local sedative useful for evacuation and diversion. We place the medicine only around the head. It is something such as rose oil since anything else cannot be applied. These drying medicines ought to be adapted to the degree of alteration of the membrane because if there is not much corruption we apply rose oil together with rose honey even more than rose oil according to the alteration. Rose honey is, however, rarely applied especially since it is rare to move the bone and to find pus beneath it if the operation has been properly carried out. There are indeed some operators who are deceived, that is, by moving a bone which should not be moved and finding no pus beneath it nor any alteration. In that case the proper application is not rose honey but rose oil alone.

Even when the operation is properly conducted and no pus is found this is due to the fact that perhaps it has not yet been generated in the wound. Possibly the moving of the bone was done at the first hour or in the first days of the lesion because of a bone which was puncturing or pressing or because of an extraneous object lodged in the head or because the physician moved the bone quickly, dubious of the necessity of doing so, but he did it as quickly as he could.

In all these cases in which there is not yet any pus we should proceed with rose oil alone in the way previously described. Hence in whatever lesion of the head which does not require moving the bone we should use rose oil to prevent the formation of an abscess especially at the beginning and thus to go on by steps from rose oil to rose honey as time passes in such wounds, following all the aforesaid directions according to the estimation of a good legitimate physician of possible symptoms to come. If they do not occur the treatment can be varied.

But although I said above that rose oil alone is not suitable to apply except around the third or fourth day because it causes putrefaction nevertheless I have often used it beyond the seventh day with good results and also as often as the tenth day. I have said also that we should mix rose honey with the rose oil more or less according to the necessity of cleansing. Note, however, that there are some cases in which we should be cautious of rose honey because of its heat and abstersive quality especially when there is danger of the flow of blood from some vein in the membrane or in the lips of the wound. Then we use rose oil with wine or when we have doubts about the honey because of its biting quality in some warm head which may cause an attraction of humor to the head, thus creating an abscess and some other bad symptom. Then the rose honey is replaced by rose julep because it is less biting and hot. Thus a prudent physician always makes an adjustment of these medicines because in a hot head and a hot season he uses rose honey more tardily than in a cold head and a cold season.

There is one thing I wish all operators of this art of medicine not to overlook. At whatever hour such an operation is conducted the humors are always set in motion even if it is conducted after the fourteenth day. Therefore it is good at such a time to seek to check and distract the humors with the application of drugs, blood letting, massage, cupping, and leeches as well as an appropriate diet although some of these means can be used to sufficiency from the beginning of the treatment since a new cause requires a new remedy more or less according to the conditions of the lesion and the patient as they appear to a rational physician. Let this suffice for a knowledge of medicines to be applied in the treatment of head lesions when the bone is incised and moved aside.

Having examined the quality of the medicine to be applied after the moving of the bone it seems to me that there has been sufficient discussion of the means of combating symptoms (by rearranging the general treatment as we have done by sedating the abscess if it forms or will be formed by local applications) both here in the third instrument of medicine as well as above in the second instrument, where local medicines were discussed in detail.

Now I come to the promises made above, that is, my preference in local medicines or applications and which I continually use. I have not turned to others unless I have been forced to do so.

First, I say that among other medicines for the exterior of the head I have found none equal to my head wax, called human because into it goes a considerable portion of human flesh, that is, *mumia*. Note that I have always seen and heard it observed by my ancestors that the *mumia* which goes into this wax plaster ought to be part of the human head and that the *mumia* of which I speak is dry human flesh. I have seen at Venice almost complete bodies of such *mumia* and always my forebears as I learned from my father and saw with my own eyes had in their house several heads of such *mumia* from which they took what they needed to make the wax plaster.

Some say that because of the similarity between this substance and the member from which it comes there is a certain symbolic relationship and affinity by which more benefit is derived than if it came from some other member of the body. Whatever this benefit and whether it comes from *mumia* or from some other source I have seen it work wonders and I believe if a way is prepared for the healing of wounds without moving the bone that this medicine alone would exceed others in its effectiveness, so great is its affinity with the complexion of the head.

In actual truth I have seen many times this unguent applied to heads wounded in whatever manner with the lips of the wound dry and with many bad symptoms and with pus of the worst kind. On the first or second day of application I have seen the lips dissolve [that is, the morbid matter of the indurated parts become soft: so *digeri*, Celsus, *De Medicina* 5.18.8], the pus reduced to a good quality and the symptoms go into remission. Thus things went from good to better in the cure. Please understand by this that I mean a case where the cure is not desperate or impossible.

I ask this alone of operators if they ever make such a plaster that they do so with all diligence and good care just as it has been freely given by me with good heart and joyful spirit into the light of day to all those faithful to medicine. I swear to God that I have seen a large amount of money offered to my father for the unguent and he completely refused to sell it, saying it was not to be given to anyone except to his own sons as if it were a precious inheritance. But I perhaps by God's urging did the opposite and have done so. I believe I shall deserve much good thereby. With what care and diligence it must be prepared and preserved will be told below.

Here is the description of this wax unguent tested by me and also the description of another medicine. Recipe: three ounces each of turpentine diluted with malmsey wine, strained pine resin, and white wax; one ounce and a half of *mumia*. Liquefy together and add the *mumia* little by little, mixing it with a spatula until mixed to perfection over a fire so as to prevent coagulation. Place the result in a silver vessel or a clean one of some other material into which you have placed four pounds of rose vinegar made from malmsey. Leave it here for a day and a night. Then knead it with your hands in the same vinegar until all the vinegar has been squeezed out of the wax. Then place the unguent into a glass or earthen vessel without vinegar and add six ounces of woman's milk, one ounce of *termentilla* juice, one half ounce of *pentaphyllum* (*potentilla reptans,* common cinquefoil), two *drachms* of *betonica* juice, one and one half *drachms* each of briony and plantain juice. Boil all these over a slow fire on warm ashes until as much liquid as you put in milk is boiled away. Afterward add one ounce of verbena juice, one ounce and a half of *pimpinella* (anise) juice and put it all in the hot sunshine, taking care that the wind does not blow dust into it by covering it with some soft thin cloth. Keep it in the sunshine for at least a month, adding each day two ounces of milk from a mother who is nursing a girl-child, one *drachm* of *betonica* juice. Thus standing in the hot sun the milk and juice would be consumed or evaporated, but once every hour some one should stir the mixture with a clean piece of wood so that it becomes perfect. But if it happens that the sun cannot dry the juice and milk because of the season, that is, because it becomes cloudy or changed in another way the unguent should be placed in a clean rinsed kettle and boiled until the ingredients of juice and milk are consumed. Thus this marvellous medicine will be prepared.

Once prepared, my ancestors took the unguent and kept it and woman's milk in some vessel in which they had poured it for an entire day. Then kneading it well with the milk they made plaster rolls of four ounces each and wrapped them in parchment. Afterward they kept them in a box which was wrapped inside and out with a piece of woolen cloth of fine grained color. Then they kept the rolls in a well-locked chest.

When they needed them they took a large piece of a roll and surrounded the wound with it to the extent of four fingers or thereabouts, having perforated the roll with many holes, and placed it on the wound above or below the bone if it had been moved. Upon the membrane they placed a small piece of the plaster stretched out on a cotton cloth and thus with some other tent or *stupe* made of thin white linen they very gently filled the wound. They applied this plaster around the seventh day unless a flow of blood prevented it, always washing the wound with malmsey wine in which red roses had been boiled. Thus they proceeded with the unguent alone to the end of the cure. They always put in two or three drops of rose honey well cooked on the bottom of the wound. This was their method of procedure and mine as well.

But since anise, *termentilla,* and some other herbs are used in the unguent from which the juice is squeezed out with difficulty they followed this order of preparation. They crushed the herbs with a pestle and drenched them with good malmsey; afterward they extracted the juice with a press but with great labor. It is true that after the first pressing they used a large thick dense sack because it cannot come forth otherwise; then they strained the mixture with a clean piece of cloth whose mesh was quite narrow.

This is the entire method of making this human unguent. I use it if I have it but rarely nowadays since I am not in a place where I can get sufficient *termentilla.* In place of this unguent I use one described below in which I also have great faith or I use my *betonica* unguent described above among my other medicines and which I have tested.

The description of the honeysuckle unguent described above is as follows. Recipe: four ounces each of turpentine, pine resin, and new wax; eight ounces of rose oil; one ounce each of mastic and incense; two ounces of Greek gum, three ounces each of pulverized honeysuckle and *betonica.* The latter two are placed in an infusion according to the art of ten pounds of the best wine for a day. Then add all the other ingredients except Greek gum, incense, and mastic and boil them all briskly until half of the wine has evaporated and in the boiling the mixture takes on a quite intense green color. Then strain and let it coagulate. When coagulated separate it from the wine, put it into a kettle and boil until the residue of wine is resolved into the unguent. This will be known by this sign when the boiling creates no more foam or hissing. This done, strain again and add to the strained substance the Greek gum, mastic, and incense finely pulverized, mixing it all on a slow fire until they are well incorporated. After this place it with a spatula in a cold place until it has coagulated. Use it by taking a larger piece which you can place on the head to cover it entirely if it can hold it. On the lips of the wound place *stupes* with the unguent proceeding with rose honey in the depths of the wound always mixed or pure.

With this unguent I use a head powder described by Galen, Haly, and Avicenna and by other founders of medicine. The recipe is as follows. I take farina of *orobus* (*ervum ervilla*), iris, long *aristolochia,* bark of *opoponax,* and incense and I make a powder. But some people add myrrh, *saracolla,* dragon blood, especially brown. Lanfranc adds grains of myrtle and cypress nuts. Others add *centaurea* and *hermodactylus* (*Colchicum Illyricum*). I use only the first with good results. Sometimes it pleases me to add other ingredients. When I see flesh granulation forming over the wound I place *hermodactyli* only on it. They dry out more and diminish somewhat the excessive granulations. If they do not suffice I place burnt alum on the wound. I use the aforesaid powder when the fourteenth day has passed and the scab is beginning to be generated, washing the wound with malmsey and placing rose honey on it. Then I scatter the powder over it, filling the wound with the unguent by means of threads of lint until the wound is sealed.

Sometimes I wash the depths of the wound with a decoction described below, especially if virulence and pus have collected at the bottom of the lesion, also using a syringe for washing it when necessary. This is the decoction. Recipe: four pounds of malmsey, a half handful each of red roses, *betonica*, anise, honey suckle, *centaurea*, *stoechas*, half an ounce of long *aristolochia*, iris, incense bark. Boil all together and reduce by a third part. Boil the roses only once and strain. To this add four ounces of well-cooked rose honey. This lotion is very effective in drying out pus in deep ulcers in the head.

My most illustrious duke, this is the lotion I prepared and made with my own hands for your head, using a syringe and sometimes an embrocation with a small sponge to reach the bottom of the wound from which earlier no small amount of pus had issued. This lotion brought about a drying out of pus and a repletion of flesh in the wound. Along with other aids it was finally consolidated.

Perhaps some will wonder at this method of procedure in head wounds by use of the syringe and washing as I described. No one should wonder since there is nothing extraordinary here. In fact, any rational physician would have to proceed thus in treating deep wounds which are cavernous and hidden. Such is the thought of all experts and especially of Avicenna on the cure of ulcers. Thus I am accustomed to operate on others by washing and syringing when necessary.

Let my readers note that these medicines should not be used from the beginning but only after the period of formation of the abscess has passed and in summer even later. From the beginning when the fourth day has passed I am accustomed to wash the honeysuckle unguent with woman's milk and I use it for three or four days. It is not so warm nor so suspected of attracting pus to the head. Some times I wash the wound with rose water, especially in a hot season and a hot head and when there is danger of a flow of blood or when there is intense fever and great inflammation in the head. Sometimes even then I wash wounds with woman's milk as I said elsewhere. I entrust all these directions to the hands of a prudent physician to use with warm, cold, and mixed means and patients according to place and time.

A Description of the Instruments

Before we come to any moving of the bone I have thought it necessary to describe the instruments which physicians should have available for use. But since such instruments must be of different shapes and kinds I shall show you their shapes as I promised. Since I find also that some authors differ on the method of operation, that is, some begin first with a broad instrument and some begin with a thin and slender one I must say something on this subject as well.

First, the instruments or iron tools are denominated in so many ways that sometimes those who hear their names are confused. Lest the operators walk in shadow I shall give you my name for each and every instrument or tool. Thus you will find their names in the pictures below. I thought it was necessary to list them in general in a kind of catalogue.

All the instruments described by physicians as adapted for perforating the bone of the head and without which it cannot be perforated are called trepan whether they are known as a gnawer (*rosorium*, from *rodo*, I gnaw) such as files and rasps or bone perforators such as the trepan or *terebellum* or cutting instruments such as the *scalprum* or scalpel and cutting forceps called *tenaglia* in Italian (pincers) or a small cutting saw or a lentil-shaped instrument called *colophysos* by Galen or some other such thing.

There are also other instruments for the head needed for pulling out bones. I shall give the names and shapes of those which have their own names. There are instruments which elevate depressed bones. They are of different shapes as are other tools required for lifting bones according to the different kinds of fractures and depressions in the bone.

All the tools have different shapes because of the diversity of human heads and their parts for the bone of one head is larger than that of another and some part of it is thicker than that of another. One shape suits one depression and one fracture but not another and one head and one depression but not another. Thus the prudent physician always has ready his instruments of all shapes and many in number so that everywhere he can extract bones if necessary and cut, elevate, saw, scrape, and grind them so as to attain a praiseworthy completion of his undertaking.

There are other instruments for extracting bones such as the forceps which do not cut but hold tenaciously called a *serpentina* by the moderns because it has little teeth in it like those in a serpent's mouth. I shall give the name of all of these or depict their shapes in their place in my text.

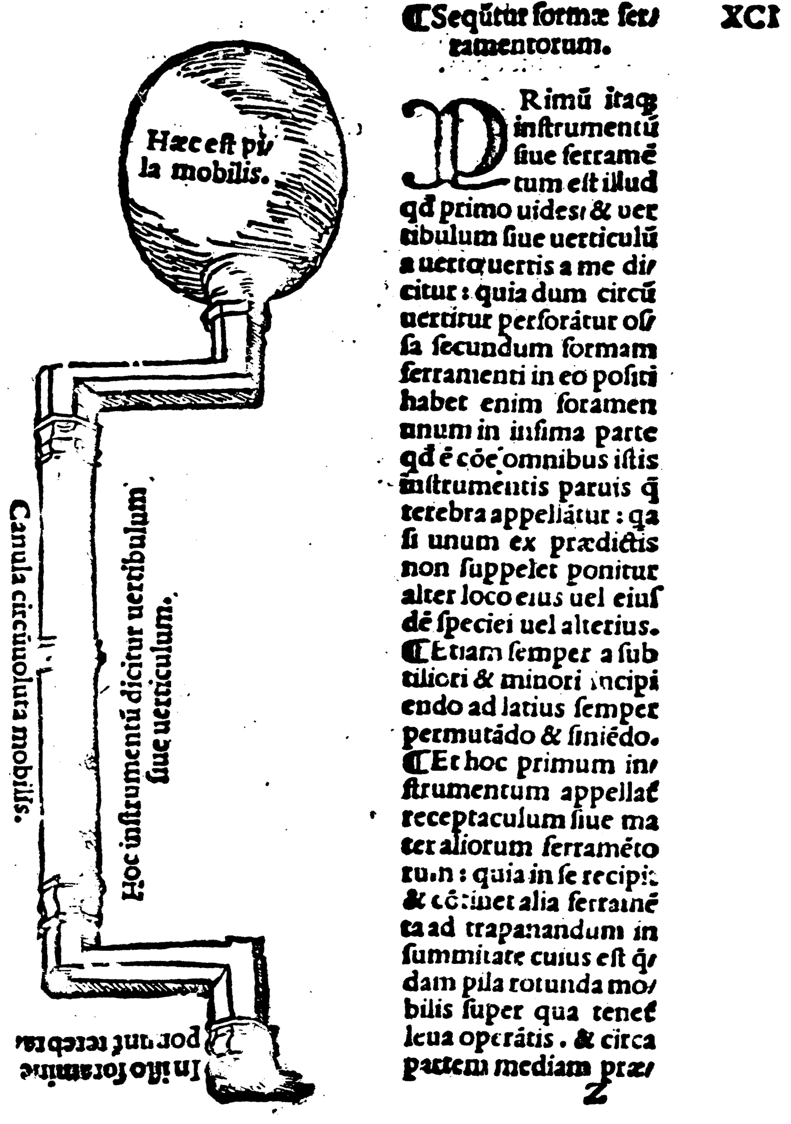
There are many other instruments whose names and shapes I shall not set down here because these are sufficient and if they are not others will be called for in the estimation of the operator. As the prince (Avicenna) says in *Canon* I, fen 1, the minimum necessary for a physician is that which can be set down in writing.

Hence I am not able to describe all the shapes of the instruments because now and then a case will come into the physician's hands which he has never seen before and he will prepare a new instrument for this case. This has happened to me many times. I immediately caused to be prepared and even made with my own hands new instruments designed for that particular fracture which I never used thereafter nor saw before.

Therefore there may be a great number of tools of every kind: very small, small, middle-sized, large, and larger. Beyond everything the physician should be ingenious and of good judgment because then he will not lack instruments. Legitimate physicians, however, have or ought to have cabinets full of such instruments.

There Follow the Shapes of the Instruments

The first instrument or tool is the one you see pictured first (1) Fig. p. XCIr. I call it *vertibulum* or *verticulum* from *verto, vertis,* I turn, because when it is turned in a circle it perforates the bone according to the shape of the tool placed in it. It has an opening in the lowest part which is common to all these small instruments which are called drills (or bits) because if one of them does not serve the purpose another is put into it in place either of the same kind or of another kind. One must always begin with a smaller and thinner drill and proceed to a broader one by changing the bit.


Hæc eſt pila mobilis.
Canula circiuoluta mobilis.
Hoc inſtrumentū dicitur uertibulum ſiue uerticulum.
In iſto foramine ponūt terebra.

¶Sequūtur formæ ferramentorum. XCI

PRimū itaq̧ inſtrumentū ſiue ferramētum eſt illud qđ primo uides: & uertibulum ſiue uerticulū a uerto, uertis a me dicitur: quia dum circū uertitur perforatur oſſa ſecundum formam ferramenti in eo poſiti habet enim foramen unum in infima parte qđ ē cōe omnibus iſtis inſtrumentis paruis q̄ terebra appellatur: qa ſi unum ex prædictis non ſuppetet ponitur alter loco eius uel eiuſdē ſpeciei uel alterius. ¶Etiam ſemper a ſubtiliori & minori incipiendo ad latius ſemper permutādo & finiēdo. ¶Et hoc primum inſtrumentum appellat̃ receptaculum ſiue mater aliorum ferramētorum: quia in ſe recipit & cōtinet alia ferramēta ad trapanandum in ſummitate cuius eſt q̄dam pila rotunda mobilis ſuper qua tenet̃ leua operātis. & circa partem mediam præ

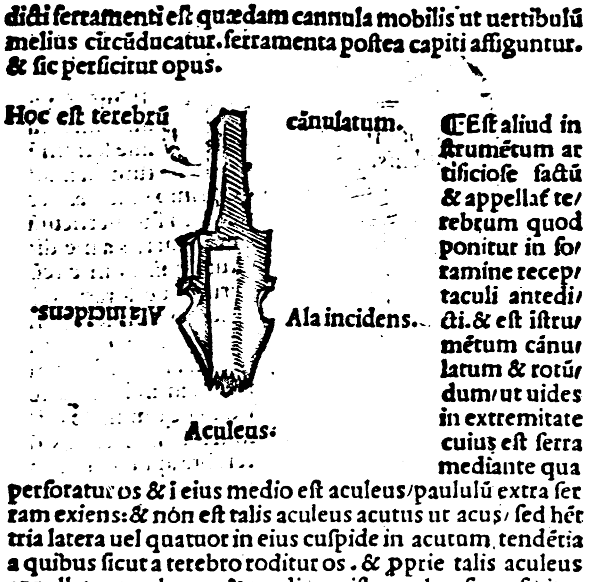
Z

The first instrument is called the receptacle [brace] or mother of the other tools because it receives into itself and contains other tools for trepanning. It has at its top a certain round movable ball which is held in the left hand of the operator. Around the middle part of the receptable is a movable tube or pipe so that the receptacle can be more easily turned in a circle. The drill bits are affixed to the head and thus the task is performed. (2) Fig. p. XCIv

Here is the drill-bit which has a pipe.

Cutting wing cutting wing

point



dicti ferramenti eſt quædam cannula mobilis ut uertibulū melius circūducatur. ferramenta poſtea capiti affiguntur. & ſic perficitur opus.

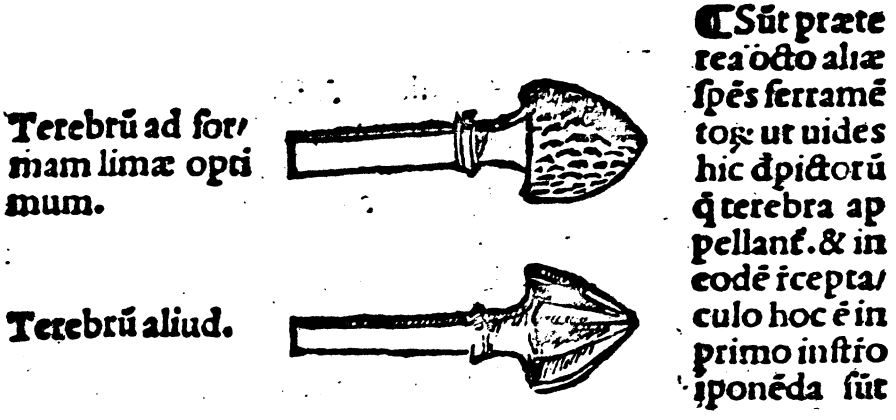
Hoc eſt terebrū cānulatum.
Ala incidens.
Ala incidens.
Aculeus.

¶ Eſt aliud inſtrumētum artificioſe factū & appellat̃ terebrum quod ponitur in foramine receptaculi antedicti. & eſt iſtrumētum cānulatum & rotūdum/ut uides in extremitate cuius eſt ſerra mediante qua perforatur os & ī eius medio eſt aculeus/paululū extra ſerram exiens: & nōn eſt talis aculeus acutus ut acus/ ſed hēt tria latera uel quatuor in eius cuſpide in acutum tendētia a quibus ſicut a terebro roditur os. & ꝓprie talis aculeus appellatur terebrum: & mediante iſto aculeo ſerra figitur

There is another instrument very ingeniously made and called a drill-bit (*terebrum*) which is placed in the opening of the receptacle [brace]. It is an instrument with a round pipe. As you see, at its extremity there is a saw by means of which the bone is perforated and in its center there is a point extending a little beyond the saw. This point is not so sharp as a needle but has three sides or four in its *cuspis* tending toward sharpness by which the bone is bored as by a drill. Such a point is properly called *terebrum*. With this point the saw is easily fixed into the bone. The point is so prepared in the tube of the brace that it can be removed at the will of the operator because it would damage the membrane of the brain if it were not removed and went too deeply into the head. Thus expert operators either remove it when they have penetrated half the thickness of the cranium or they have another instrument without a point (*aculeus*) and thus complete the task by penetrating to the remaining surface of the head. This instrument with the point is called masculine, that without a point is called feminine. But this instrument has points or wings which as you see are very thin and able to cut. They keep the instrument safe from impinging upon the brain because the sharp point would penetrate but the broad part prevents it from doing so. This instrument or another almost similar is always used by the Bolognese as Guy de Chauliac says [in his *Grande Chirurgie*, ed. Nicaise, p. 268]. This instrument in my judgment exceeds all others if it is handled by an expert and diligent physician.

There are in addition eight other types of instruments as you see in these pictures which are called drill-bits and are to be fitted into the receptacle, that is, the first instrument described according to the judgment of the operator (3) Fig. p. XCIIr. The shape of each you see here, and as I said before of each kind you should have five varieties, that is, very small,

(3) Fig. p. XCIIr



Terebrũ ad for/
mam limæ opti
mum.

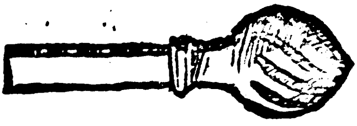
Terebrũ aliud.

¶Sũt præte
rea octo aliæ
ſpẽs ferramẽ
to℞ ut uides
hic đpictorũ
q̃ terebra ap
pellant.& in
eodẽ ĩcepta/
culo hoc ẽ in
primo inſtr̃o
ĩponẽda ſũt

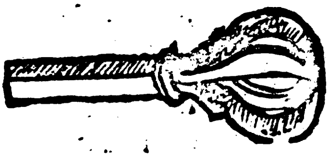
(3) Fig.p. XCIIr

[continued from p. 138]

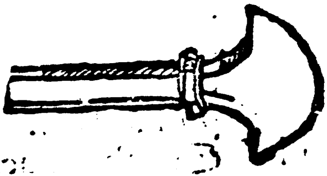
Terebrū aliud.



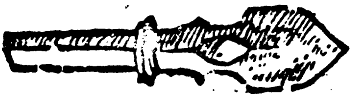
Terebrū aliud.



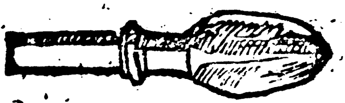
Terebrū q̄d nō cōuenit fixure.



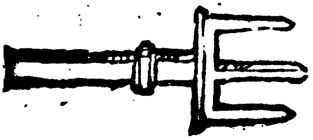
Terebrū q̄d nō cōuenit fixure.



Terebrū aliud.



Terebrū q̄d nō cōuenit fixure.



ꝑut uidetur oṗanti & formā cuiuſlibꝫ ſpeciei uides hic & ut prius dixi d̄ q̃libꝫ ſpē ad minus ſunt habēda quinq̃ inſtrumenta ſcilicet minima pua media magna ⁊ maiora.

¶ Sciat etiā opator q̄ ex iſtis octo inſtrumētiſ nō ſūt niſi quinq̃ apta ad operandum ubi eſt prius aliq̄ fixura in craneo pp̄ ipoꝝ formā rectā ad formā lineæ: qa cum linea r̄cta ſer

Z ii

small, middle-sized, large, and larger.

Let the operator know that from these eight instruments there are only five suited for operating where there is first some fissure in the cranium because of their shape like that of a file. If it had the shape of a straight line it would descend deeply into the fracture toward the membranes especially if the fracture is rectilinear. But if it is semicircular instead of circular it can be used without danger of descending too deeply into the head.

There is in addition another instrument as you see also called *trepanum non profundans*, the drill which does not go deeply into the interior of the surface of the bone, but almost. On the testimony of Haly this instrument is called *terebellum*. Its head is short lest by chance it should penetrate to the dura mater of the brain. Its length corresponds to the thickness of the bone. Galen, *De Ingenio Sanitatis* IV, chapter 6 [Vol. X K. 446-447], speaks of this instrument: He says: "Whence some physicians on account of their apprehension about the foramen [i.e., of injury to the membrane] made such instruments in order to penetrate only the thickness of the bone; hence many different instruments had to be made according to that thickness." Avicenna calls this instrument *trepanum* and a perforator which does not go deeply. Abulcasis also calls it *terebrum non profundans* and says it is so called because it does not penetrate to the membrane since it has a round blunt extremity and a little ring which prevents the drill bit from going too deeply. Such is the instrument pictured here, and I certainly believe it is the same one of which Abulcasis, Avicenna, and Haly speak. They also give the method of its use, but I would not dare to operate with such an instrument unless I were forced to do so since I prefer the first instruments and some others to be described below. However, I wished to describe it to show the tools used by the ancients. (4) Fig. p. XCIIr [see p. 141]

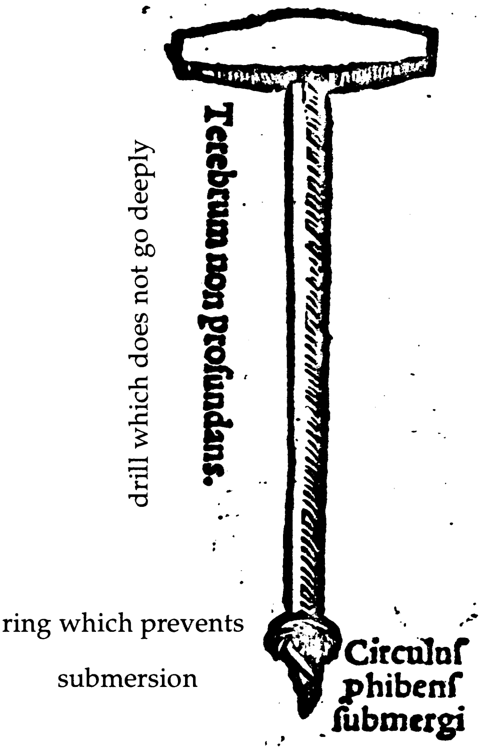
Galen praises a certain instrument called *colophysos* which is not among those used today, but I believe it is that round saw I described above without wings which many operators use at the present time and quite well. Nevertheless, it is dangerous. If it has wings it is safer than the instruments aforesaid.

There are in addition as you can see two instruments called forceps. One is for cutting bones and is called a cutting forceps, much needed by the operator. If he knows how to use it he can complete his craniotomy quickly but the way must be prepared for it so that it can be fixed upon the spot where the operation is to take place. (5) Fig. p. XCIIIr [see p. 142]

Avicenna mentions this instrument in his chapter on skull fracture where he says: "If the bone is weak by its nature or by reason of the fracture it has suffered then you must extract it by use of cutting instruments placed against other such instruments [i.e., two grasping jaws opposed to each other]. Haly also speaks of this instrument when he says: "If the bone is thin cut it with an incisor similar to a sickle which has two parts opposed to each other."

(4) Fig.p. XCIIv

ramenti eſſet i directo fracturæ p̄cipitaret ſupra pãniculos & maxime hoc intelligit̃ ubi fractura eſt cũ linea recta : ſed ſi eſſet ſemicircularis uel circularis ẽt iſtrumẽtũ de p̄dictis poſſet adminiſtrari ſine periculo aliquo de p̄cipitatione.



¶Eſt præterea hic aliud iſtrumẽtũ ut uides ẽt trepanũ appellatũ nõ ꝓfũdãs uſq; ad iteriorẽ oſſis ſuperficiem ſed prope.

¶Q̃d inſtrm̃ teſte Haly.dr̃ terebellũ cui caput eſt breue ne forte eius caput ad matrẽ pforet cerebri ſitq; capitis eius lõgitudo q̃ta eſt oſſis ſpiſſitudo.

¶De iſto ẽt ferramẽto loq̃t Gal. vi.igenii.c.vi.inq̃t unde q̃dã medici pp ſuſpitionẽ foraminis talia fecerũt inſtr̃a q̃tenus nõ niſi ſolũ oſſis ſubſtãtiã penetrarẽt qua pp multa & diuerſa ſunt facienda ſecundũ quãtitatẽ groſſitiei uniuſcuiuſq; partis oſſis.

¶Hoc ẽt inſtrm̃ ab Auic. noiant̃ trepanum & perforatorium non profundans.

¶Et ab Albuc.ẽt dr̃ terebrũ nõ ꝓfũdãs. & dicit ꝙ nõ noiat̃ ita niſi qa nõ ptrãſit terminũ cranei ad illud qd̃ eſt poſt ipſum.i. ad ſiphac ppterea ꝙ terebro eſt extremitas rotunda & circulus paruus prohibens terebrum ſubmergi.

¶Et ita eſt iſtud inſtrumẽtũ hic pictũ: & certe credo ꝙ hoc ſit illud de quo loquitur Albucaſis & etiã Auic.& Haly.

¶Modũ aũt operandi cũ eo dant Haly. Auic.& Albuc. ſed ego nõ auderẽ opari cũ iſto inſtr̃o niſi coactus cũ mihi magis placeat prima inſtr̃a & aliq̃ alia de inſradicẽdis, ſed hoc inſtrm̃ poſui ut mõſtrarẽ ferramẽta q̃bus utebant̃ antiq.

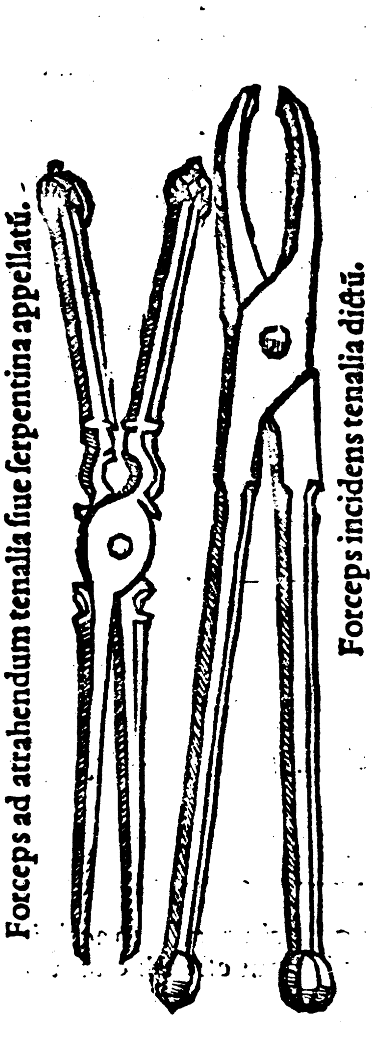
¶Sed Gal.laudat certũ inſtrm̃ colophiſos dictũ ꝙ a Modernis nr̃is nõ repit̃. ſed credo ꝙ ſit illa ſerra rotũda ſupius

ii S

(5) Fig. p. XCIIIr

poſita ſine alis cū q̄ ēt nūc tp̄is multi opant̄.& ēt ſatis bene quis nō habeat alas tñ eſt ferramētū piculoſum . ſed ſi hēt alas antedictas tutius eſt inſtrumētis cæteris prædictis.

XCIII


Forceps ad atrahendum tenalia ſiue ſerpentina appellatū.
Forceps incidens tenalia dictū.

¶Sūt præterea hic ut uides duo inſtrīa q̄ forcipes appellātur unū eſt ad incidendū oſſa & dr̄ forceps incidēs quo q̄dē inſtrīo multū indiget operator.& certe ſi eo ſciat medicus opari breui tp̄e pficiet oē opus de oſſis amotiōe maxime ubi cadit ei⁹ opatio qa oportet q̄ prius huic inſtrīo ſit pſtita uia ut poſſit figi i loco in quo q̄ritur opus.

¶Et de iſto inſtrīo facit mentionē Auicē.in.c. de fractura cranei dū īquit & ſi os fuerit d̄bile ex natura ſui aut ex fractura q̄ accidit ei tūc oportebit ut auferas ipſum cū inciſoriis ponendo q̄dā.inciſoria cōtra alia & iſta inciſoria certe ſunt forcipes ſiue tenaliæ icidētes ſupra dictæ : qa unū inciſoriū eſt contra aliud.

¶De iſto ferramēto ēt loqtur Haly.dum inquit:& ſi os ſubtile inueneris incidas cū inciſorio q̄d falci ſimile ē poſitis ipſis in oppoſito &c.

¶Eſt aliud etiam ferramentum forceps dictum ad capiendas & extrahēdas ſagittas tela ſpinas oſſa & huiuſmodi extranea capiti uel alibi fixa tenalia ſiue ſerpentina appellatum.

forceps for extraction called *tenalia* (It. *tenaglia*) or *serpentina*

forceps for cutting called *tenalia*

There is another tool also called forceps for seizing and extracting arrows, spear heads, thorns, bones, and such extraneous objects which have become lodged in the head or elsewhere. It is called *tenalia* or *serpentina*.

There follows another instrument called a large elevator which we use for lifting depressed bones as you see here. Its extremity is placed under the bone and lifted upward as far as the operator intends. (6) Fig. p. XCIIIv [see p. 144]

There follows another instrument called a hawk's beak with which bones are also elevated when there is need as you see here.

There are also three other tools called *scalpra* as you see here which the moderns call rasps (*raspatoria*), (7) Fig. p. XCIIIIr, quite safe for use in operating but demanding more labor than the other instruments especially when the entire thickness of the bone must be perforated. Each is called a hooked *scalprum* but sometimes one uses a *scalprum* instead of a razor or a sharp knife for bloodletting or for whatever utensil is needed for cutting flesh and soft parts of the body. [see p. 145]

These hooked *scalpra* are the instruments which operators must use in trying to penetrate a hair-line fracture. First one must begin with the winged tool as will be told in greater detail below. These instruments are mounted on a handle of bone, iron, or wood and they are threaded like a snail shell so that they may enter the handle and be more firm to grasp, as you see in the picture above. (8) Fig. p. XCVr [see p. 146]

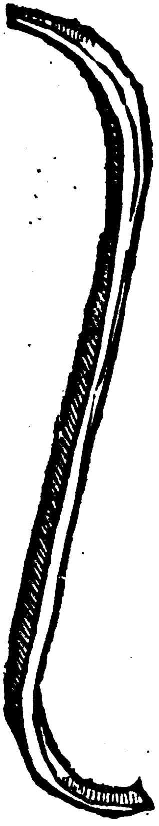
There are four other instruments as you will see, one of which has the shape of a saw; it is sharp and biting like a file at the sides as appears from the picture.

There is another tool called a straight *scalprum* or scalpel somewhat convex and concave in the *cuspis* as you see. This instrument is ideal when the bones are stony hard and into which other tools cannot penetrate because of the narrow orifice of the wound, especially when the physician does not intend to perforate the bone completely. This instrument is struck with a lead hammer pictured below as you see.

There is another instrument, the lenticular or *lentiticium*, much praised by Galen among other instruments which is also struck by a lead hammer so as to produce less noise thanks to which the brain of the patient is less disturbed. It has at its *cuspis* a small portion of iron shaped like a lentil seed so as to prevent puncture of the membrane of the brain. With this instrument operators level out the roughnesses of the bones of the head so that they may not puncture the membranes. They also cut the bones with it if necessary, especially if the way is already prepared in the bone by a fissure through which such a tool can enter the bone.

Abulcasis and Avicenna hold that this instrument derives from Galenalthough he does not mention it in *De Ingenio Sanitatis* VI, chapter 6. For this reason in addition to other reasons I have expressed I return to my opinion that we do not possess the sixth book of *De Ingenio* in complete form but that it lacks the seventh chapter. Thus with the Lord's assis-

(6) Fig. p. XCIIIv



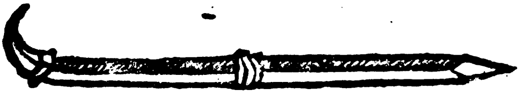
Eleuatorium magnum.

large elevator

¶Sequitur aliud inſtrumentū qđ eleuatorium magnum appellat̃ quo utimur ad eleuādā oſſa dep̄ſſa ut uides hic cuius extremitas ponit̃ ſub oſſe & eleuatur os ad ſuperius quantum intēdit operator.

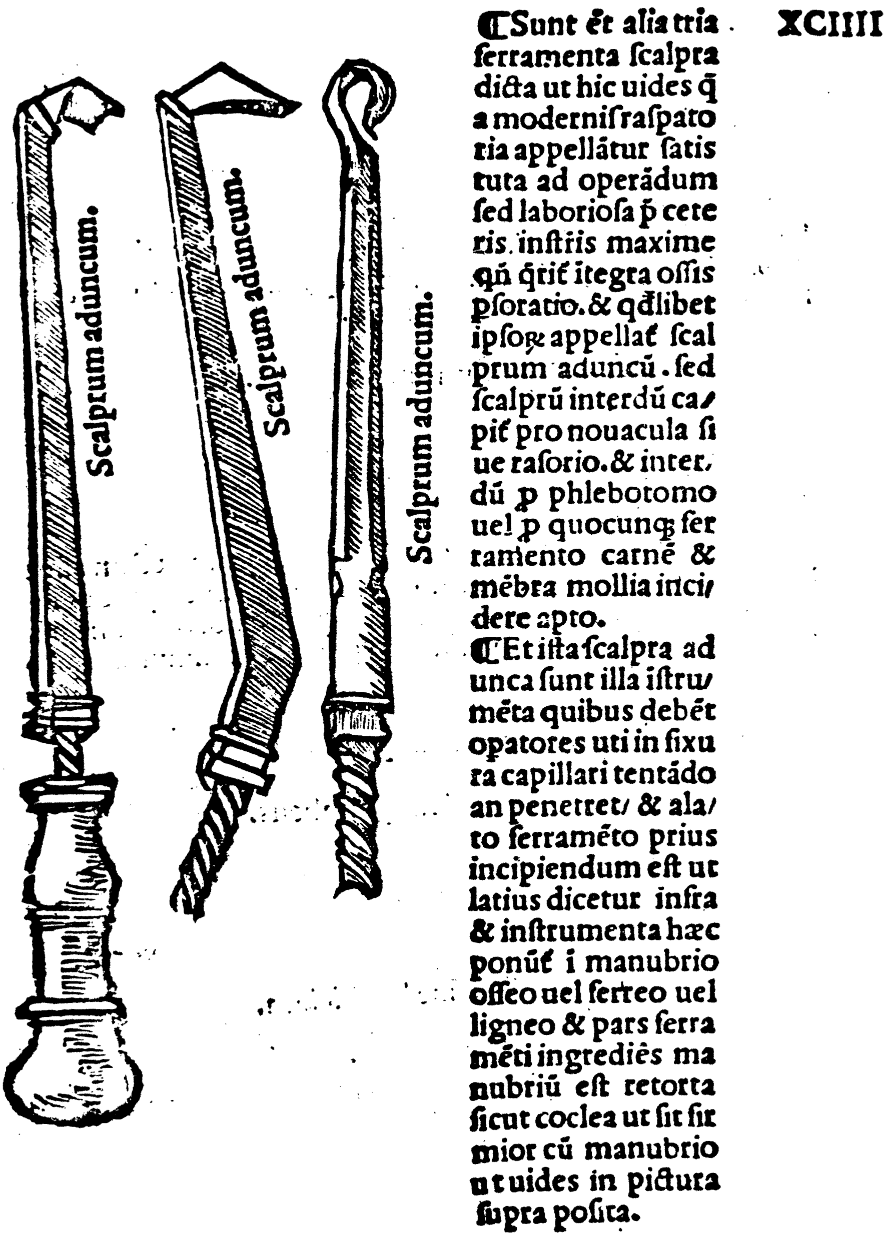
small elevator called a hawk's beak

Eleuatorium paruum qđ apellatur roſtrum accipitris.



¶Sequitur aliud ferramentum qđ dicitur roſtrum accipitris cū quo etiam eleuantur oſſa ubi opus eſt ut hic uides.

(7) Fig. p. XCIIIIr



XCIIII

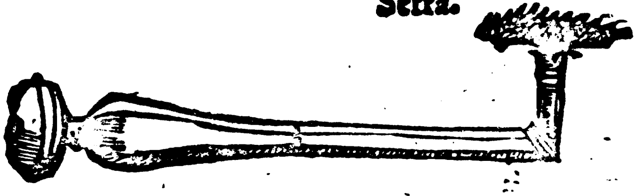
Scalprum aduncum.
Scalprum aduncum.
Scalprum aduncum.

¶Sunt ét alia tria ferramenta ſcalpra dicta ut hic uides q̃ a moderniſ raſpatoria appellãtur ſatis tuta ad operãdum ſed laborioſa p̃ ceteris inſtr̃is maxime qñ q̃rit̃ itegra oſſis pſoratio. & q̃dlibet ipſoꝝ appellat̃ ſcalprum aduncũ. ſed ſcalprũ interdũ capit̃ pro nouacula ſiue raſorio. & interdũ ꝓ phlebotomo uel ꝓ quocunq; ferramento carnẽ & mẽbra mollia incidere apto.

¶Et iſta ſcalpra adunca ſunt illa iſtrumẽta quibus debẽt opatores uti in fixura capillari tentãdo an penetret & alato ferramẽto prius incipiendum eſt ut latius dicetur infra & inſtrumenta hæc ponũt̃ i manubrio oſſeo uel ferreo uel ligneo & pars ferramẽti ingrediẽs manubriũ eſt retorta ſicut coclea ut ſit firmior cũ manubrio ut uides in pictura ſupra poſita.

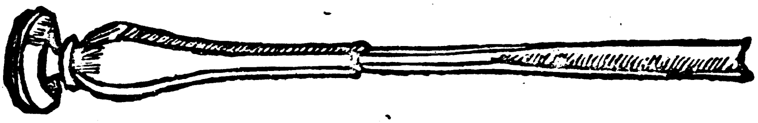
(8) Fig. p. XCVr

saw **Serra.**



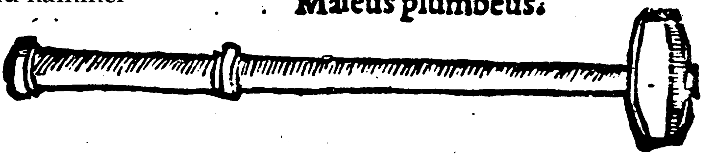
¶Sunt ultra prædicta inſtrumenta alia quatuor ut hic uidebis quorum unum eſt ad formam ſerræ quæ a lateribus eſt aſpera rodens ut lima ut hic ſuperius uides.

Scalprum rectum ſiue ſcalpellus.

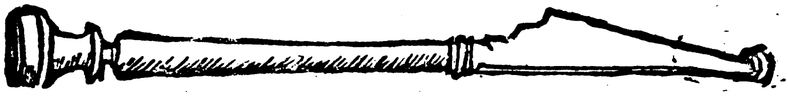


¶Eſt aliud ferramentum quod dicitur Scalprum rectum ſiue Scalpellus/ aliqualiter conuexum & concauũ in cuſpide ut uides hic/quod inſtrumentum eſt præcipuum ubi oſſa ſunt petroſa in quibus alia ferramenta non poſſunt adminiſtrari propter ſtrictum orificium uulneris/ & maxime quando medicus non intendit integre perforare os.quod inſtrumentum percutitur maleo plumbeo hic inferius picto ut uides.

lead hammer **Maleus plumbeus.**



Lenticulare ſiue lentiticium.



¶Eſt aliud inſtrumentum lenticulare ſiue lentiticium a Gal/ multum laudatum inter alia inſtrumenta quod percutitur etiã maleo

tance I have finished the description of the forms of our instruments. Who wishes more information on them should refer to other books. I repeat this word alone: for all the instruments described there is a great diversity in their sizes because of the reasons already presented.

Chapter XVII

Whether or Not One Should Begin With a Broad Instrument or a Narrow One in Removing the Bone

Having examined the names and forms of the surgical instruments or tools adapted for use with the aforesaid lesions we must see which should be used first, especially as was said above since there are some who use first a narrow thin instrument and then a broad one. As Abulcasis says the operation is carried out with one of two methods, one by cutting the bone with a thin cutting tool, then using another broad cutting tool and after that another even broader. Thus you must have at hand a number of different cutting tools of which some are broader than others. He also says they must be extremely sharp and of Indian iron in order to cut easily without disturbing the brain of the patient.

The second method is used if the bone is strong and hard. Then you must perforate all around the bone with a *terebrum non profundans* before you use cutting instruments. That drill has a small ring around it to keep it from submerging and passing through the thickness of the bone. You should have a large number of these drill bits available so that you can select one that fits the thickness of the bone so that you may have one to use for the entire cranium whose sharp extremity and size, both long and short, may be adapted to the thickness of the skull.

Avicenna holds that you should begin with the winged drill bit and then move toward the narrow tool in his chapter on skull fracture. He says you should have tools of different sizes, using a broad one first and then a narrow one. A little lower down he says that if the bone is weak by nature or from the fracture which it has suffered then you must remove it with cutting tools first with a broad and then a narrow one until you come to the capillary fracture, that is, the fracture requiring the thinnest and finest tools.

Niccolò says the method of those who begin with a narrower tool is to be rejected even in capillary fractures. He adduces Abulcasis in favor of his contrary view. He says you should in your first abrasion of the bone use a broader scraping tool. Then use a narrow one and do not cease to do this according to the fracture until you come to use the thinnest and most slender of the tools.

In addition to the authority of Abulcasis Niccolò says the reason why we should begin with a broad instrument is that the upper part of the orifice of the wound must be broader than the lowest part on account of the danger of putridity since pus is more easily purged if the orifice is broad and medicines, tents, and *stupes* more easily introduced. He also adduces the authority of Galen, *De Ingenio Sanitatis* VI, chapter 6, who says you should begin with a broad instrument, that is, with a broader and larger one until you pass to the narrowest and smallest. In his favor Niccolò also gives the testimony of Avicenna presented above.

But note, reader, that Abulcasis, Avicenna, and Galen cited above are correct when they say you must begin with a winged instrument as Abulcasis also believes when he says you must begin with a narrow one. Niccolò, however, poorly skilled in manual operation, did not know how to distinguish the methods of procedure with either broad or narrow tools and thus said you must begin with the winged one only. In order not to leave my readers confused and bewildered I must say in which case first the broad and then the narrow instrument must be used. I say one should start to operate on a skull fracture with a winged tool when the fracture does not penetrate the inner surface or table of the cranium. Then the physician proceeds tentatively rather than with a definite plan since he does not intend to penetrate the entire bone with such instruments. He begins with the sole purpose of seeking to lay bare the small capillary crack and to see whether it penetrates into the bone by placing black ink or some black liquid upon it. Even if it does not penetrate he seeks to widen such a fissure on the surface of the bone lest pus be retained in it and cause some bad symptom.

That this is expressly true is the view of Galen and Abulcasis that one must begin with a winged instrument when the fracture does not penetrate and these are Galen's words: "That which penetrates to the place which lies between both parts of the cranium is thin. It is necessary to have different instruments so that you may begin with a winged instrument, then proceed to one less broad until you come to a thin one."

Abulcasis says if the fracture of the bone does not penetrate to the membrane and that which is cut off the bone is its surface and there remain on it roughness and patches you must scrape them off with a scraping tool of which you must have at hand a number of different kinds to use at any time and in every place and straighter ones if the operation requires them. You should use a broader one first and then narrower ones. In addition to the aforesaid authorities who presuppose a beginning with a broad tool where the fracture does not penetrate the reason is this: the operation with a broad instrument allows the operator always to see to what depth within the cranium he should go; this he could not see if he had first worked with a thin narrow instrument.

But in a fissure penetrating inward it is sufficient to have instruments adapted for penetrating the entire cranium and to remove the bone. The membrane is also always separated from the cranium when the physician intends to perform trepanation as has been pointed out above or when the bones puncture or are heavy upon the membrane or when pus has flowed down into the wound, all of which separate the membrane.

Then it does not make any difference if the physician makes good use of the narrow tool before he uses the broad one because he has already measured the thickness of the cranium at the point to be perforated in relation to the tool and thus he has no fear of damaging the membrane. But when the bone is fractured only with a straight fissure he hesitates to penetrate and to injure the membrane. Hence he wishes to have a broad path before him lest he make an error and especially when such an operation must be made before the separation of the membrane to prevent the pus from descending through that crack and penetrating the pores of the cranium and thus separating the membrane since the operation is made for no other reason than to keep the pus from collecting and damaging the bone.

But there is another stronger reason why the physician should use a narrow thin instrument before he intends to make a complete perforation and moving of the bone in the interior. He may risk the patient's death before operating with a broad instrument for when the instrument has a broad path before it it can easily penetrate inward and thrust itself to fall upon the brain since it has nothing but the physician's uncertain hand to guide it. Therefore one must begin with the narrow instrument as long as we wish to penetrate the entire bone. This is what Abulcasis meant when he said the thin instrument should be used to begin the operation.

That this is true, lofty duke, you have already proved with your own head because one of my colleagues, anxious to operate, began first with a certain instrument of middle size and then changed to a straight slender one. The instrument finally entered violently under your cranium from which experience you escaped unharmed although you were in some danger. Therefore let operators beware of beginning with a broad instrument when they wish to penetrate the cranium with instruments.

That it is better to do this is shown by experience in every other mechanical craft whether one works with wood, stone, or some other solid material because craftsmen always use a thin small drill, then a broad, then a broader one because it is better and quicker to accomplish their task in this way.

From what has been said it seems that Abulcasis, Galen, and Avicenna were correct and spoke very well since it has been shown that there are some cases in which one must begin first with the winged and some in which first with the narrow and slender tool. I also believe one must begin now with the slender instrument, now with the broad one according to their various forms if the operation is performed with the *scalprum*, that is, raspatory, then you begin with the winged tool. If you use the drill and forceps then you begin with the narrow slender tool whether the bone is completely perforated with *scalprum* and drill or not.

It often happens that one uses only one instrument without change from winged to narrow and vice versa. I have often seen one instrument suffice.

A Brief Summary Worthy of Note and Necessary to the Art of Medicine

But before I turn to the special task of the instruments (i.e., cranial operation) I have thought it worth while to list everything I have said at length in this entire book in a kind of catalogue so that readers may more easily understand what must be done and how and when. A ten-times repetition is accustomed to please, and, as Seneca says, that is never said too often which is never sufficiently learned (*Epistles* 27.9). Galen also in *De Crisibus* VIII, chapter 1, (Vol. IX K.) says: "Something which provides assistance ought to be repeated many times and encouraged." In *Megategni* it is said: "A repeated discussion is helpful because it is more easily committed to memory."

It is to be noted therefore that in the more prominent wounds of the head the chief principles or procedures have been set down by me and must be listed, that is, blood letting, cupping, application of leeches, and brisk massage of the part opposite to the wound.

Cleansing the bowels with an appropriate drug, clyster, or suppository.

The entire regimen of the six non-naturals.

The extraction of extraneous objects without discomfort to the patient.

Checking the flow of blood with the appropriate and necessary means and preventing the ebullition of the blood by evacuating and halting the bile.

The preservation of the patient from symptoms which can be corrected if one has recourse to a faithful and experienced physician.

As soon as possible the skin should be cut with a triangular or quadrangular incision and in a lower spot, checking the flow of blood with egg and coagulating powders or bringing the lips of the wound together with other means for at least a day; then the lips should be more open and less painful.

Before all, a prognostication of the danger should be made in order to forestall the idle talk of fools. Guy de Chauliac postulates such a peril on the authority of Roger as far as the hundredth day and according to jurists to the forty-sixth day because that is the last for acute fevers and according to the four masters up to the fifteenth day.

The patient should be advised at the first visit of the physician that he should confess his sins to God according to the chapter on penitence and pardon in the *Decretals* since the illness is often produced by reason of those sins before the doctors of the souls are called because thus excommunication is avoided. In this way patients are healed better and more quickly from many causes of illness.

The bone should not be moved aside when the patient's strength is low except through urgent necessity, but the sooner this is done the better.

The surrounding air should always be more or less warm in summer according to the foregoing conditions, however.

The sutures should be left intact in the operation if the membrane is not separated. If it is then the operation can be conducted in safety.

Such an operation should be made on the lower side because it is thus easier to purge the wound of pus.

In the dilatation of the wound one should not reach the bottom of the fissures. It will suffice to bring out as much of the bone as may facilitate the purging of pus. The entire fissure should be opened, however, so that the pus is not retained. With a light rubbing the area should be washed and cleaned with some skill so that corruption does not occur and the penetration of pus inward.

The operation should be performed as quickly as possible so that it may not weaken the patient.

A good operator should be chosen who has often seen other operations and has firm hands and good eyesight. He should finally be a legitimate physician.

During the operation the patient's ears should be stopped with cotton or wool so that he will not be disturbed by the noise of the operating instruments.

There should be at hand an abundant supply of different forms of instruments.

During every operation there should always be present at least two assistants to help the operator when necessary and to hold down the patient to prevent him from moving and impeding the operation.

If a suture must be made it should not be done when the lesion occurs at the very top part of the head.

Whether or not a suture must be made at the very top of the head it should have good care and diligent inspection to keep it from retaining pus because this can corrupt the bones and membranes. In such a case the patients should be placed in such a position that the head will be depressed in order not to retain the pus.

Often in such a case the wounds should be medicated and always kept clean of filth.

Let rose oil and other medicines which sedate pain be used only at the beginning of the treatment, that is, not beyond the fourth or seventh day or at most the tenth. Then dry medicines should be administered as was said above.

The rose oil should be made from unripe olives and prepared in the year it is used because otherwise it is harmful.

At the beginning a repercussive medicine should be gently used. Nevertheless, the pus should not be driven back from the outside to the inside.

The medicines should not be very styptic nor obstructive (oppilative) for the same reason since pus is conculcated by such medicines and rendered disobedient to art and to nature. Rose oil and myrtle oil are sufficient around the wound especially in a contusion.

A medicine which bites or stings or causes pain should be used as lightly as possible if it proves necessary to use it.

The wound should be medicated with change of bandages once, twice, and more times according to the quality and quantity of the pus, the place where it is located, and the symptoms caused by the pus.

Above the *stupes* should be placed a piece of sponge in order to better drive away the pus from the bottom of the wound.

When much bone has been moved, lest the bandages and tents compress and burden the membrane place immediately above the first *stupe* or the linen cloth placed on it a small piece of dried gourd or some other light substance a little larger than the piece of bone that has been moved.

Make the bandage light, not pressing, especially until the wound becomes covered with flesh.

From the beginning such a bandage should be only retentive; afterward it should be incarnative and somewhat tighter.

If the bones have been altered by the air, medicine, pus, or by all these together one of two things must be done. Wait until the bones emit their squamous altered superficial substance which takes place when the abscess is formed because it is not so resistant as in other bones. As I have seen many times, in the breakage of the head in place of the lost bone there is generated a certain ligamental substance similar to the *dura mater* to which the substance of the *dura mater* adheres in a very powerful manner. I have seen it while anatomizing some heads which I had cured with a considerable moving of the bone. If the bones are lightly and superficially altered the emission of their superficial substance takes place within thirty-five days or thereabouts.

But if the bones are deeply altered as often happens the emission of squamous material takes place much later and even later according to the complexion, strength, age, and season because sometimes it takes more than a year until it is aided by cautery or medicine. There are many reasons for this tardiness.

Another thing which must be done if the bones are altered superficially is that the physician should rub them at least each day with a raspatory and clean them well of the altered matter, beginning when the period of the abscess has passed. This process will cause the bones to be more quickly covered with flesh, the wounds will be filled and will not emit any squamous material. The bones thus cleansed attract nourishment to the spot and the cure is more quickly completed. I always proceed in this manner especially if the passage is broad enough for me to use instruments.

I wish the young men of this profession to know one thing. When the *dura mater* is laid bare it always becomes covered again with flesh and produces so much of it that some people believe it suffers an abscess. Then they use plasters as a cure made of fenugreek, linen seed, chicken fat, and such like. The flesh then grows even more and becomes soft and rises above the membrane like a mushroom. The medication and increased flesh in turn produce pus and consequently bad symptoms. The operators should watch out for signs of abscess in the membrane and decide whether it is abscessed or has merely added flesh and follow an appropriate treatment.

The treatment for superfluous flesh is to dry it out with *hermodactyli* [a tuber, *Colchicum autumnale,* or meadow saffron], alum, sugar, burnt alum, apostles' ointment, toasted gourd, sponge, or the like in which there is no poison or evil effect. For the treatment of the abscess see what has been said above on that subject. Sometimes the membrane becomes abscessed and issues from the cranium like *alfuturati*, that is, a fungus, as Avicenna says in *Canon* III, fen 1, chapter 4, p. 184r.

Chapter XVIII

How to Operate With Instruments On the Aforesaid Lesions of the Head

We must now turn to the special task of instruments in whatever kind of head lesions. Let those beware of this operation who are not legitimate physicians. No one should approach this work unless he is much practiced in the art or surgery and who has not seen many such operations conducted by an experienced and expert physician.

But as Zoar [Avenzoar, a Spanish Arab, end of the eleventh century: *Morbos Omnes*, etc., Venice: O. Scotus, 1542] says in his *Theizir* I, tractate 2, in his time and perhaps in ours few men can be found who know how to operate on fractures of the head using instruments rationally and with experience. He also says that for such a task a man of intellect and familiarity with such operations should be found, one who by nature and complexion is skillful in the art and has practiced it for a long time, since he must not be accepted unless he has served as a disciple of a most perfect master in surgery and has himself practiced it for a long time.

Such an operator on the anatomy of the skull should be instructed in the thickness and hardness of parts of the cranium so that he may know the places from which issue nerves, veins, and all other parts contained in the head.

We may say that the first kind of fracture is that called *rhagamia, darca,* or capillary (hair-line) which although it sometimes does not penetrate fully to the inner cranium yet presents a very grave doubt to the physician concerning penetration and bad symptoms for the sutures. This non-penetrating fracture is dangerous if not cared for as it should be.

This kind of fracture can be more accurately called a doubtful fracture and is caused by contusion. Its treatment with instruments is as follows. At the first hour of the lesion as was said before unless something prevents doing so the head must first be shaved. Then make two incisions which meet at right angles in the form of a cross, one along the length of the fissure made by the percussion. The four corners of the incisions should then be lifted until the entire bone which you wish to perforate is laid bare. In order to halt the flow of blood fill the fissure with a cloth soaked in vinegar and water or a dry cloth. Then place bandages soaked in wine and olive oil or rose oil upon the wound and apply an efficient binding cover. When morning comes and no bad symptoms have appeared to hinder the task remove the bone.

This is the method of Paul of Aegina, Haly, Avicenna, and some others of the ancients. They do not insist that this should be done at the first hour or the first day except in the cases mentioned earlier, but as I said elsewhere above if necessity compels I recommend that the procedure be carried out because of the reasons I have brought forward. If it is not done in the first hour then the faster the better.

Let the operators note that when there is doubt about the formation of an abscess after the rubbing with a raspatory or because the body has bad chyme or when there is the possibility of a flow of blood on account of the operation or there is ebullition in the head and in the humors due to another cause than the head wound itself, then it would be better to wait for the period of hesitation concerning an abscess to pass and to place the treatment as I have said many times into the hands of a prudent and legitimate physician.

More recent physicians do not, however, always make a quadrangular incision but often content themselves with a triangular one nor do they use vinegar and water. I would not dare to use them either in head wounds because of what I said above about vinegar, but they use egg and powders to check the blood flow. Afterward if there are no symptoms preventing it they turn to the instruments in the morning for that time is a more suitable one than any other.

Before they begin they close the patient's ears with wool, cotton, or something else so that the noise of the instruments may not disturb the person whose bone is being operated on. When the wound is opened and cleaned order two assistants to lift the lips of the wound with some cloth or other means and keep them open. Then the operator should take up one of the instruments called *scalpra*. The country folk call it raspatory.

Along the length of the crack an abrasion is made beginning with a broad instrument when the black ink used earlier to mark it has been removed. This was used in order to see whether the crack penetrated. If the crack does not penetrate the entire cranium every vestige of the ink should be removed. Then Galen's treatment in *De Ingenio Sanitatis* VI will be used. Once the abrasion is made one must medicate with iris, farina of *orobus*, incense, *aristolochia*, and with every medicine which cleanses without creating pain.

This method of treatment is to be selected above others if the physician is certain the fracture does not penetrate since often pus is retained in such a fissure, especially if it is at the top of the head because such wounds do not purge the pus as the lateral wounds do. The pus can injure the membrane. Therefore physicians in dealing with such a fissure are very cautious in ordering such a position so that pus is not retained in the lips of the wound and that through the crack or the pores of the cranium it does not descend inward and corrupt and injure the brain. Hence raspatories can remove the crack as quickly as possible. Then they dry out, fill up with flesh, and finally consolidate the wound by administering a reasonable diet and drink as was said above together with proper general care.

In the aforesaid kind of lesion the symptoms of separation of the membrane are not expected, but such a task is carried out only to keep the pus from injuring the membrane by descending through the pores of the bone. Yet often even without such an operation such illnesses are healed with careful attention to the patient. However, the first way (i.e., entering the wound) is safer nor is there in it any apprehension of lesion of the membranes by means of instruments. In fact, one should begin with them in the order set forth already. Then one proceeds to the proper medicines and thus to a successful termination of the treatment. Physicians must note, however, that this crack is not always revealed by the use of black ink because sometimes the fissure is so narrow that nothing can enter it. I have witnessed this myself in my practice. I once placed ink on the bones and no vestige of its blackness remained. Then after some time nature emitted quite a noticeable amount of squamous matter from the bone and in the process revealed a sizable fissure. The reason for this is that while the bone is still living it is full of humidity throughout which impedes the entrance of extraneous liquid into the fissure. When the bone is dried out, however, the fissures in it are apparent.

But if one proceeds tentatively and the crack is found to be one that penetrates the physician should by no means dare to enter the inner region with instruments unless there are first signs of the separation of the membrane because he could injure the latter with any instrument. He should continue the treatment with medicines which sedate pain and dry out the wound according to the time required by the illness and as the disposition of the patient responds to the treatment. Very often patients are healed by proceeding without the use of instruments in an operation.

But if symptoms force the physician to open the bone and to move it aside as far as the membrane one must use other tools although the raspatories just mentioned are suitable for penetrating the entire bone to such an extent that many use them alone even though other instruments are less troublesome for both patients and operators since those instruments can perforate bones in the shortest time. Bones are perforated by the *scalprum* or raspatory with long labor and much time. Hence we must turn to other tools such as the drills described earlier.

The physician should choose the instrument which seems more suitable for this kind of lesion. I would in this case use that instrument, a counter-sink, which looks like a round file and that one equipped with a round pipe or *cannula* and with cutting wings whose forms you saw above. I would postpone entirely the use of those tools shown above which on account of their rectilinear form might descend along the length of the crack within the cranium if the crack is a straightline fracture. But if it is oblique all the drills described are suitable according to the choice to be made by the operator since one physician prefers one tool and another physician another tool.

I prefer above all others the *trepanum* with a crown or point (bit) which can be used in the place more adapted for purging or drainage. When you turn the handle it perforates the bone, beginning with a small narrow drill bit. Then I use a broader one and then one even broader as the passage requires for the removal of pus from within the cranium. I leave the drill bit in the circular saw until the two tables of the thickness of the cranium are perforated or thereabouts. Then I remove the drill bit to avoid puncturing the membrane since it is so placed in the instrument as to be removable by the operator. Or I take another saw without a drill of such size as the first and perforate the entire cranium as far as the membrane. Thus the job is completed safely, quickly, and without much movement of the head.

If it should happen during the operation with this instrument or another after the removal of the bone that there should remain some troublesome roughnesses (*asperitates squirlae siue satagiae*) which might puncture the membrane they are removed with forceps or with some other means, particularly Galen's lenticular and the lead hammer, directing the end of the lenticular toward the membrane and its cutting edge toward the bone to be removed and then removing the roughnesses and patches mentioned.

When the task is completed with instruments the blood and pus should be cleaned away. Then one proceeds with rose oil or rose honey pure or mixed insofar as the situation requires, filling the wound with *stupes* or drains between the bone and the membrane dipped in medicine considered suitable until flesh forms again on the wound.

There are some who in the spot where the bone has been moved aside place a piece of dried gourd on the bandage so that the tents do not weigh upon the membrane, a procedure I neither condemn nor approve. I have sometimes used this and sometimes proceeded without it. Things went well just the same. In one case alone I approve the application of gourd, that is, when a large part of the cranium has been moved aside and there is some apprehension that the bandage and tents may weigh heavily on the membrane. Then, I think, there is much advantage to its use because it prevents the formation of an abscess due to the pressure of the tents. Upon such tents, *stupes*, and bandages I place my head unguent, rose honey, and rose oil as required. Nonetheless, I always anoint the head with oil from unripe olives for seven or eight days after the operation whether it is performed in the first days or when the pus has formed beneath the bone since on account of the craniotomy with instruments the humors are agitated and run to the injured spot. The head is comforted by the oil and resists the humors and repels them with its stypticity. Not only do I use local medicines but a proper diet and regimen and drink, as I have pointed out above. I complete the treatment with the use of the syringe and the powders already referred to. Finally, I use medicines which produce consolidation of the wound and a scab.

Care must be exercised in the form of fracture called *aberia* or *angin* which involves the removal of the first table or surface of the bone. In this the *dura mater* is separated. This kind of fracture is more to be feared if it is located on the top of the head on account of the pus which is more likely to enter there and descend inward. When the symptoms are perceived one must open the bone at once and follow the procedure described with the use of drills. When the bone is brought away one proceeds as usual with drainage of the pus and the rest of the treatment.

This method is suitable for the treatment of the kind of fracture called *marusis* or *monesis* in which the bone is ruptured within the head toward the brain and not outward. The craniotomy ought to be carried out when such symptoms appear as pus or puncture or compression of the membrane. The exact spot for the operation should be carefully ascertained by the physician for the perforation of the bone which should not be made directly above the puncturing bone since the instrument would press down even more upon it and cause a larger puncture. Hence in the operation the perforation should be carried out in such lesions on the margin of the lesion taking a large part of the healthy bone in the process so that the bone may not compress or puncture the membrane. This work is done successfully. It should not, however, be undertaken by anyone except an expert in this art and one of good judgment. Then the treatment should proceed as usual.

This type of treatment is suitable also for the fracture called *hesena* in which the bone is folded inward especially if symptoms force the physician to carry it out. I have often seen such cases without bad symptoms healed with plasters, especially with my human unguent and with the *betonica* plaster I have described. I have seen other cases in which the bone remained permanently depressed without any harm. If, however, symptoms supervene the bone must first be perforated with some drill placed in a healthy spot in the neighborhood of the compression by the bone, making a foramen large enough to position an instrument which can elevate the bone.

If it happens that the entire depressed bone is separated from the *dura mater* and from the pericranium it should be completely removed. If instead it is firmly attached to both or to one of them it should be elevated to its original position since it will probably be consolidated there especially if it is a piece of considerable size, for as I said before the bone draws life from the membranes by means of arteries and veins. If the bone is small it should be completely removed for reasons known to the expert. This done, whether or not the bone is removed, the local treatment should be as previously described.

The treatment with the drill also is suitable for the kind of fracture in which some vein is ruptured in the hard membrane. If the cranium itself is not fractured symptoms which are accustomed to occur when the membranes are separated from the cranium will indicate what opening must be made. The place where the perforation must be made I leave up to the legitimate physician since such treatment is possible especially if a vein is ruptured between the cranium and the membrane and a physician perforates the bone at a point convenient for drainage and drying out of the pus.

But if the vein is ruptured between the *dura* and *pia mater* without a perforation in the direction of the opening for operation on the bone a cure is impossible except by a strong nature in whom the pus is transmitted through the nostrils or other places. Nevertheless, from this kind of fracture very few patients recover. Those who are saved owe their lives to the diet and drink prescribed earlier. Operators are quite fearful of this type of fracture.

The aforesaid method of treatment with drills is also suitable for that type of lesion in which the membrane is contused by the bones between sutures. The physician recognizes such a fracture by some swelling produced at the location of the sutures or by some other symptom among some very bad ones. When the incision is made if one sees the bone laid bare at the place of the aperture and changed in color at this spot the bone is perforated because the membrane is separated and the rest of the treatment should be continued. If there is any way to salvation in this type of fracture it is solely through operation on the bone.

So I say that if the bone happens to be perforated in whatever other type of fracture which has a separation of the membrane from the cranium in correspondence with the sutures the moving of the bone can be safely carried out. I have done this operation many times with success. There is no difference between the area of the sutures and other areas in the operation as long as I know by symptoms that the *dura mater* is separated from the cranium.

There is not such a great danger in operating in the sutures as some say for we see cauteries applied to them which reach to the first membrane above the bone (pericranium) to which the *dura mater* is attached. There is no great harm as a result. It is true that if the opening can be made elsewhere then in the sutures it should be made since the *dura mater* is attached to the pericranium in the sutures more closely than elsewhere as we have shown above. When the operation with instruments is completed in the aforesaid type of fracture I order the continuance of medicines as set down above.

The treatment of that type of fracture called *apostatismos* or *cutomatos* or *ascialis* in which the bone is completely removed as far as the membranes is as follows. The physician must see if beyond the bone which has been removed there is something else which must be moved since sometimes, and almost always, in a dry body whether the bone has been cut by a sword or something similar and is split into different parts of which some are puncturing and others are rough there is something which requires removal. Then with a cutting forceps or Galen's lenticular the bone must be smoothed likewise because also in such a fracture although the bone is removed as far as the membrane the foramen is not sufficient for purging the pus contained within. Therefore it must be widened with forceps or the oblong saw or lenticular or the large drill (*terebellum*). Then the residual treatment with medicines must be continued.

The treatment of that type of fracture called *empiasma* or *antiaca* in which the cranium is broken into many parts and descends upon the membrane or punctures or weighs upon it is as follows. As soon as possible the physician should remove the shattered bone which cannot live any longer in its position either with forceps or lenticular or the oblong saw. The healthy bone which prevents the disrupted and broken bone from coming forth should be cut. Afterward proceed with the usual treatment with medicine as needed.

If the bone happens to be perforated with an arrow or a dagger or such things, when these are first extracted then with every effort one must dilatate the skin in the manner aforesaid. Then if the symptoms are urgent and there is need the foramen of the bone should be widened with drills in the form of a file or some other instrument so that the pus can be purged if there is any. If the symptoms indicate an abscess the craniotomy will be of little help. The treatment should be completed with appropriate medicines to dry out the wound.

I have postponed this method of treatment with instruments beyond all other methods of treating the aforesaid lesions so that readers and operators might know that they should attempt all other remedies before turning to an operation because as I said above other ways and methods should be tried before resorting to instruments. But having realized the necessity for doing so the sooner we turn to operation the better. Let these words suffice for what was to be said by me concerning skull fracture. I beg your pardon for my long- windedness. I could certainly have concluded my discussion with a shorter discourse, but as I said before that which is handed down in practice cannot be told in brief. Hence, writing for the benefit of younger men, I have thought it not inconvenient to proceed in some detail especially when I saw that Galen, the leader among others of physicians, had followed the same path. Thus let Him who is three and one be praised and may He direct us to higher things.

Amen.

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